An Opportunity to Grow Peanuts (*Arachis hypogaea*) Commercially in Northland: A Concept Paper.

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Kellogg Rural Leadership Program, Group 32, 2015

Contents

1.0 Summary

The Peanut (*Arachis hypogaea*), also commonly called groundnut is a summer growing legume that has been identified as a potential cash crop for Northland Farmers.
Peanuts have been grown in New Zealand in the 1980's but the enormous labour needs at harvest have prevented large scale production. With the availability of modern machinery large scale peanut production is now achievable. The Far North District Council and Northland INC have identified the Mid North as a possible site for a peanut processing factory. This study looks at peanut production from a world perspective right through to the opportunities for New Zealand and Northland farmers. The data from this study shows that a peanut industry could be a viable option for Northland farmers through growing and marketing a premium product that would attract a premium price.

2.0 Introduction

Having grown up in the Far North and being passionate about growing plants, I'm always interested in new cropping opportunities for our family farm and Northland farmers.

After going to a local fieldday in Kaikohe in 2014 the Far North District Mayor commented that Agriculture and Forestry was the backbone of the local economy (Carter, 2014) and that the Far North district council and Northland INC have been looking at new or different opportunities to build the local economy with one option investigating the viability of building a peanut processing factory in the mid north.

After learning that peanuts could be grown in Northland I have been intrigued about the production of peanuts as a crop and the opportunity for Northland farmers to grow peanuts as a crop and the infrastructure would be needed for a viable industry.

Small studies have been completed back in the 1980's with successful results, but due to a lack of machinery and the intensive labour needed to harvest the crop by hand, areas bigger than 1 hectare are rare (Anderson, 1981; Griffiths, 2003). With the manufacture of modern machinery larger areas could now be efficiently cultivated and planted in Northland by using precision seed drills used for planting maize and importing peanut diggers and thrashers from Australia or America.

This paper looks into world peanut production, the New Zealand market, climate and soils required for peanut production, through the agronomic and growing process to the processor and consumer, to ascertain if there is a viable opportunity to grow peanuts as a crop in Northland and what opportunities there could be to diversify our family farming operation in Northland.

3.0 Methods.

This paper is based on a literature review style where published scientific research papers, market reports, reputable web based data providers and edited books have been used to find the relevant information and market data to ascertain if growing peanuts could be a viable crop for Northland farmers.

Most of the information used has been American or Australian information as this has been more readily available and relevant to New Zealand conditions. Some New Zealand information has been used where available.

Agronomic and technical information have been extracted with relevance to New Zealand pests and diseases, along with chemicals that are available on the New Zealand market. Some chemicals are under review by the Hazardous Substances and New Organisms Act and are subject to change.

4.0 World Production.

World peanut production currently sits at a ten year average of 45.654 million tonnes (MT) of in-shell peanuts (FAOSTAT, 2013). The top five world producers ten year production averages are shown in table 1.0. Australia is very small producer in the world producing 21,837 tonnes (FAOSTAT, 2013)and fluctuates between 17,000 and 45,000 tonnes (FAOSTAT, 2013) depending on climatic conditions and the severity of drought (QDAFF, 2015).

Figure 1.0 World Peanut Production Ten Year Average (FAOSTAT, 2013).

Country	**World Production**	**Mainland Cnina**	**India**	**Nigeria**	**USA**	**Indonesia**	**Australia**
Peanut Production (MT)	45.654	13.268	7.156	2.780	1.837	1.283	0.021

Across the world the area of peanuts planted increased by 1.04%, with an increase of 2.05% in total production and an increased yield of 0.99% for the same period (FAOSTAT, 2013). The production increase is due to an increase in area planted and yield advantages from new cultivars (Revoredo, 2002).

The Food and Agriculture Organisation of the United Nations (FAO) data shows that China's total cultivatable peanut area has declined by 0.15%, but production has lifted by an average of 2.44% and yield has increased by an average of 2.6% from 2003 to 2013 (FAOSTAT, 2013). This rise in production and yield was achieved by using higher yielding seed varieties and improving agronomic practices in crop cultivation within China (Gleeson, 2014) .

In contrast, India's peanut growing area and production have both declined, with the area planted being reduced by 2.47% and production being reduced by only half a percent. The difference being made up by the 2% increase in yield (FAOSTAT, 2013) from using advanced cultivars (Gleeson, 2014). This increase in yield is not surprising due to India being the largest global producer of peanut seed (FAOSTAT, 2013). India's peanut production fluctuates between 4.4 and 9.4 MT. This fluctuation comes from competition of producers following more lucrative alternative oil seed crops such as soybeans and cottonseed (Gleeson, 2014).

Production in the United States of America (USA) has seen a decline of 1.7% in peanut area for the last 10 years, although production has increased by an average of 1.2%, following an average increase of yield of 2.93% from 2003 to 2013 (FAOSTAT, 2013).
The USA's total production has remained fairly constant for the last 20 years at around 1.8 MT of peanuts. A favourable year in 2012 saw peanut production nearly double from 1.7 MT to 3.1 MT due to an outstanding year with good rainfall and low pest and disease pressures (APC, 2014). The biggest asset to the USA's peanut industry is having a comprehensive breeding and extension program which has been crucial in improving crop yields by giving growers access to the latest cultivars and agronomic information (GPC, 2015).

5.0 World Market.

The world peanut market can be considered a residual market (Fletcher, 2006) as most of the production is consumed domestically. World peanut exports totalled 1.776 MT (4.4% of world production) in 2012 (FAOSTAT, 2013), of the total exports five countries exported 1.318 MT (74%).

Table 2.0 illustrates the top 5 exporting countries, their total peanut exports and percent share of world exports. These exports were mostly supplied to the European Union, Vietnam, Indonesia, Mexico, Russia, Canada and Japan (Gleeson, 2014).

Table 2.0 World Peanut Exports (FAOSTAT, 2013).

Country	**World Exports**	**India**	**Argentina**	**USA**	**Netherlands**	**China**
Peanut Exports (MT)	1.776	0.653	0.222	0.174	0.134	0.133
% of World Exports	100%	36%	12.5%	9.8%	7.5%	7.5%

China is the most interesting as it is the world's largest peanut producer, producing 13.083 MT in 2012 and exported only 133,678 tonnes, consuming 98% of its 2012 crop (FAOSTAT, 2013).

Trade in peanuts is relatively small with only 4.4% of world production being traded in 2012 (FAOSTAT, 2013). China was once the primary supplier of peanuts in the international trade, but growing domestic consumption has led to lower exports in recent years (Gleeson, 2014).
World Consumption of whole edible peanuts is 24.887 MT (61%) of 2012 production (FAOSTAT, 2013) some of which are processed into cereals, snack foods, confectionary and peanut butter (QDAFF, 2015). The remaining 39% (16.0 MT) is crushed producing 6.0 MT of peanut meal and 5.0 MT of peanut oil (Gleeson, 2014).

Trade in peanut meal and oil is very small, with global exports in 2011-12 only 66,000 tonnes of peanut oil and 170,000 tonnes of peanut meal.

Crop payment is based on the quality and cleanliness of the 'Farmers Stock' (peanuts in their shells straight from the farm). At the buying station or processor a sample is taken from the incoming load, with the peanuts being inspected to establish kernel content, size of pod, moisture content, damaged kernels, foreign material and any fungus present.

Peanut prices vary with peanut type and quality. Limited information is available on farm gate prices. The Texas Peanut Producers Board published average farm gate peanut prices of U$467.94 per tonne for Runner peanuts, U$449.01 per tonne for Spanish peanuts, U$473.20 per tonne for Valencia peanut and U$473.20 per tonne for Virginia peanuts (TPPB, 2012).

The United States Department of Agriculture published an average farm gate price of 19.4 cents per pound (42.68 cents per kg or U$426.80 per tonne) (USDA, 2015).

Prices for shelled and blanched peanuts are variable depending on country it's produced and quality of the kernel.

Alderbaran Commodities reports international peanut prices according to European Union quality specifications. Prices for quoted American medium runner peanuts U$1,360 per tonne, U$1,390 per tonne for Jumbo Runner Peanuts and U$1,600 per tonne for blanched American peanuts (van Valzen, 2014).

Argentinian peanuts are quoted at U$1,450 per tonne for raw edible runner peanuts and U$1,600 per tonne for blanched peanuts.

China quotes U$1,800 per tonne for raw edible Hsuji peanuts.

Alderbaran also report that the spot price for Argentinian edible runner peanuts at U$1,600 per tonne and American medium runner peanuts at U$1,475 per tonne (van Valzen, 2014).

The Queensland Department of Agriculture, Fisheries and Forestry have reported a price of A$925 per tonne for high quality edible peanuts (QDAFF, 2015).

6.0 Market Size.

The New Zealand market is relatively small, importing a total of 9,761 tonnes of in-shell equivalent in 2012 (FAOSTAT, 2013). Along with the 9,761 tonnes of peanut products imported New Zealand imported 2,213 tonnes of shelled peanuts in 2012 (FAOSTAT, 2013).

There is an opportunity in New Zealand to build upon the niche market that has been created by small New Zealand growers in the 1980’s (Griffiths, 2003) and grown by two peanut butter manufacturers in New Zealand: Pics Peanut Butter and Fix and Fogg who have created niche peanut butter for domestic consumption.

With New Zealanders becoming more aware of where their food is coming from and the concerns about added preservatives, a growing demand for wholesome natural foods has grown where consumers are prepared to pay a premium.

Fix and Fogg, a Wellington based company is producing natural peanut butter and flavoured natural peanut butter (Jewell, 2015). Fix and Fogg use Australian Hi-oleic Peanuts or Argentinian Hi-oleic peanuts when the Australian crop is in short supply.

Hi-oleic means they have a high proportion of omega 9 (monounsaturated fat), which has been linked to reducing cardiovascular disease and lowering cholesterol (DEEDI, 2007). Fix and Fogg are accredited by Conscious Consumers for their commitment to recycling and reducing food waste.

With their efforts around producing a high quality product Fix and Fogg are selling their peanut butter for NZ$8.50 per 375gm jar for standard peanut butter and NZ$9.50 per 375gm jar of flavoured peanut butter.

Pics Peanut butter uses only Australia’s Kingaroy Hi-oleic peanuts. Pic’s recipe is simple, Peanuts and a bit of salt. Pic’s business started after the founder was horrified at the taste of peanut butter available in New Zealand and after finding that commercial peanut butter contains added sugar, he started producing his own peanut butter for himself and a few friends. Popularity grew and Pic purchased a concrete mixer to roast the peanuts, a tonne of Australian nuts and table top grinder and started producing peanut butter (Picot, 2015).

Pics Peanut Butter is now the top selling peanut butter in New Zealand with 33% more share than any other brand 2014 Aztec data (Picot, 2015) and is now exporting to Australia, Singapore, China, USA and the United Kingdom.

Pics Peanut butter retails for NZ$6.50 per 380gm jar. Pics also sell cold pressed extra virgin peanut oil which retails for NZ$10.00 per 250ml bottle.

7.0 Peanut Types and uses.

There are 5 main types of peanuts: Runner Peanuts, Spanish Peanuts, Valencia Peanuts, Virginia Peanuts and Forage Peanuts.

The Runner peanuts are the most widely consumed variety. Runner peanuts have an upright prostrate growth habit (DEEDI, 2007). Runner peanuts have a good flavour and great roasting characteristics, making them the most consumed variety of peanuts (TPPB, 2015). Runner peanuts are a medium sized peanut and is ideally used for manufacturing and for peanut butter production. Runner peanuts need sandy well drained soils for best performance.

Spanish Peanuts are most widely used in confectionary, peanut snacks and peanut butter production (TPPB, 2015). Spanish peanuts are easily defined by their smaller kernels and reddish brown skins. Spanish peanuts have a high oil content, which makes it ideal for the crushing market.
Spanish peanuts are an early maturing crop (100-150 days), show no seed dormancy and the plants are characterised by flowering on both central and lateral branches. The pods of the Spanish types cluster more tightly around the crown of the plant (DEEDI, 2007).

Valencia peanuts are a sweet peanut with a bright red skin. The peanut usually contains three or more kernels in a longer shell (TPPB, 2015). Valencia peanuts are mostly served roasted, sold in-shell or boiled.
Valencia peanuts have similar growth characteristics as the Spanish types, having flowers on central and lateral branches and having the pods cluster close to the plants crown (DEEDI, 2007).

Virginia peanuts, often called "cocktail nuts" are a large kernel type, which is favoured for processing, mainly into the salting, confectionary and in-shell roasting (TPPB, 2015).
Virginia types are characterised by showing flowers on alternate lateral branches, with the seed showing some dormancy. Virginia peanuts are a late maturing crop (120-170 days) and have both erect and prostrate growth habits (DEEDI, 2007).

Forage peanuts are used for grazing and groundcover. Forage peanuts are a different species (*Arachis pintoi*) than peanuts grown for their edible kernels (DEEDI, 2007). Forage peanuts have small kernels and are not suitable for the edible trade. Forage peanuts have a creeping habit and are stoloniferous (Heritage, 2011), producing a good cover of highly nutritious fodder. Forage peanuts are initially prostrate and are extremely tolerant of heavy grazing.

8.0 Seasonality of Production.

The peanut is a summer growing legume that has a medium to long crop maturity (100-170 days) depending on location and cultivar sown.

Peanuts are sown in the late spring where 9 am soil temperatures are 18^{o}C and rising with little risk of frost for the entire growing season. Plant emergence starts to show 7-10 days after planting.

Peanut crop life-cycle is fairly accurately estimated using Growing Degree Days (GDD) or Thermal Time (TT).
TT is calculated as the accumulation of heat units above a base temperature of 9°C up to an optimum of 29°C. Thus, a typical day of 35°C maximum and 23°C minimum will yield a mean daily temperature of (35+23)/2=29°C, and a TT of 29-9=20°C day-degrees or GDD. The thermal time for each day throughout the season is then added together to give the total heat units for a particular environment.

Virginia and runner types require about 550°C GDD to progress from planting to the beginning of flowering, 950°C GDD to the beginning of pod fill and 2150°C GDD to maturity (DEEDI, 2007).

Due to peanuts being a medium to long maturity crop only one crop is grown per year. For some growers this will be the only crop they can fit into the rotation for that paddock, although autumn sown winter cereal crops or short rotation annual ryegrasses could be sown after the peanut crop as a spring silage crop before cultivation in the spring for the following crop, similar to what North Island farmers do with their maize silage crops (Pioneer, 2015).

9.0 Peanut Production.

9.1 The Peanut Plant.

The Peanut (*Arachis hypogaea*) also commonly called groundnut is a summer growing legume. The peanut being a legume is not a true nut, it flowers above ground then the petals fall off as the fertilised ovary begins to enlarge. The ovary or "peg" grows down from the plant, forming a stem which extends to the soil. The peanut embryo is in the tip of the peg, which penetrates the soil.

The embryo then turns horizontal to the soil surface and begins to mature taking the form of a peanut. The plant continues to grow and flower, eventually producing over 40 mature pods (VCP, 2012a; TPPB, 2015). The peanut grows in a similar manner to Subterranean clover seed (Bolland, 1987).

Like other legumes the peanut forms a symbiotic relationship with rhizobia in the soil which allow the peanut to take nitrogen in from the atmosphere and fix it in the soil where it is used by the plant for growth and production.

9.2 Climate.

Peanuts are originally from South America, but are now grown in many tropical and subtropical areas. They prefer warm weather and cannot tolerate frost (Ham, 2004). The optimum temperature for their growth lies between 22°C to 30°C. If the temperature consistently exceeds this range, the plant tends to produce a large bush and low pod yields. This is often the case when peanuts are grown in the wet season. During cool spells (below 22°C) such as experienced in the dry season, the time to maturity is increased. The longer maturation period encourages more efficient transfer of plant resources to kernel production. Hence dry season peanuts tend to be higher yielding and have smaller sized bushes.

Although peanuts are relatively drought tolerant, the production of quality high yields requires at least 550 mm of rain during the growing season. Considerably more rain than this is usually necessary to ensure reliable yields and quality. A fully irrigated crop requires between 550mm and 650mm of irrigation water (for crops planted in March/April) (Ham, 2004).

9.3 Soils.

Soil type is one of the most important aspects to consider before growing peanuts. Peanuts yield best in well-drained, friable soils. Soil texture determines if a soil is suitable for peanut production. Peanuts will grow and produce a crop in most soils, but the ability to harvest the crop with minimal losses determines the soil's suitability for peanuts.

Peanuts grow best on well-drained sandy loam soils, where the crop gets full sun. Peanuts can grow on sandy or excessively-drained soils as long as reliable irrigation or rainfall is available to prevent the plants getting stressed and yield being affected.

Peanuts grown on poorly drained soils are prone to waterlogging and disease can be prevalent, with yields being low (Wright, 2006). To achieve high yields on poorly drained soils crop growing time will be extended due to the extra moisture lowering soil temperatures (DEEDI, 2007) and the extra sprays needed may make the economics of the crop not viable.

Planting peanuts in well-draining friable soils also aids harvesting the crop. The inverters used to lift the crop and leave it lying on the soil surface need to penetrate the soil to a depth of 10-15cm.

Soil fertility and pH is important for growing peanuts. Soil tests should be taken prior to planting and any deficiencies remedied before planting begins.

Peanuts require a pH in the range of 5.5 to 7.0. A pH of 6.2 is preferred. If soil is more acidic <5.5 pH, nodulation and nitrogen fixation can be reduced and trace element imbalances can occur, potentially causing aluminium and manganese toxicity. If soils are more alkaline >7.0 pH, deficiencies in zinc and possibly iron can develop (DEEDI, 2007).

Peanuts require high levels of nitrogen, moderate levels of phosphate, very high levels of potassium and a very high level of calcium. Nitrogen is less of a concern with peanuts if the seed has been inoculated, as the rhizobium will allow the peanut plant to fix most of its nitrogen from the atmosphere. If the crop is showing signs of yellowing or where waterlogging has taken place topdressing with 50 kilograms per hectare (kg/ha) of nitrogen will remedy the yellowing of the crop. Starter fertiliser containing 20-30 kg N/ha may be needed in soils with low available nitrogen. This starter fertiliser will give the plant enough nitrogen until nodulation occurs, which happens about one month after emergence.

Phosphate is needed in lesser quantities than nitrogen. Peanuts will use 5-30 kg P/ha to grow to maturity. Peanuts require 65% of their phosphate at flowering, where a topdressing of 10-15 kg P/ha is recommended at flowering.

Potassium is one of the higher amounts of nutrients required by the peanut plant. Potassium is required to grow the crop canopy and to foster good root and pod development. Potassium should be applied to the soil before planting and preferably deeper than 5 cm. Peanuts are able to extract more potassium from the soil than they need, especially in the seedling stage. As a result potassium content in the plant can be high in the early growth stages until flowering, when the potassium starts to be redistributed from the leaves to the pods.

A peanut crop will remove 10 kg K/ha for every tonne of peanuts harvested, along with this removing peanut hay will remove 20 kg K/t DM.

Calcium is required by the peanut and is a major factor in kernel development and quality. Only 10-14% of calcium taken up by the plant ends up in the pods, most of the calcium is in the foliage (66%) and roots. The shells and kernels extract their calcium directly from the soil as the sap of the plant does not carry calcium down the peg to the pod (DEEDI, 2007). Care needs to be taken when applying other nutrients as high concentrations can inhibit calcium uptake by the plant, especially potassium.

A low calcium content can affect the germination of the peanut seed and reduce the plants ability to resist diseases like *Aspergillus flavus* (the cause of afflotoxin) and some pod rots (DEEDI, 2007).

Where soil pH is acceptable but calcium is low, soluble sources of calcium like Gypsum can be applied. Applications of 400-600 kg/ha are recommended at flowering to aid in pod development.

Micro-nutrients are important to growing peanuts. The two main nutrients are Iron, used by the plant in fixation of nitrogen, and boron, which prevents “hollow heart” which reduces kernel weight reducing the quality and value of the crop (Wright, 2006).

A full breakdown of the macro-nutrient requirements and micro nutrients required by different soil types is shown in Appendix 3.0 and Appendix 4.0 respectively.

9.4 Growing Cycle.

Peanuts are planted in the late spring when soil temperatures are around 18ºC and there is no risk of frost for the whole growing season. Peanuts need to be planted with rhizobia inoculum added to the seed prior to planting. The inoculum infects the peanuts roots allowing the plant to produce and fix nitrogen into the soil. Mycorrhizal fungal infections to the roots also form a symbiotic relationship with the peanut plant, helping the plant to access more nutrients and moisture from the soil (Wright, 2006).

Peanut seed germinates best when soil temperatures are between 20-35ºC. The radicle takes between one to two days to emerge, with the taproot being 10-15 cm long at around day 10. Shoot emergence will show between 7-10 days after planting (DEEDI, 2007).

Warm temperatures of around 25–30°C will prompt vegetative growth, while the optimum temperature for reproductive growth is around 22–24°C. Schedule planting so that crops experience warm temperatures early in the season followed by cooler weather for flowering and then mature before there is any risk of frost.

To determine when to sow, measure the soil temperature at planting depth at 9 am each day. When temperatures of 18–20°C are recorded three days in a row, it is time to plant. If seeds are sown into cool soil, emergence will be slow because the seeds and seedlings are more susceptible to disease attack. Rain within two or three days of planting will lower soil temperature and may affect emergence if the soil temperature falls below 18°C.

As minimum temperatures drop below 17°C, peanut growth begins to slow down. Dry matter production drops by about 25 per cent when night temperatures reach 15°C and by 50 per cent by 9°C. The plants virtually cease growing and pod-filling long before it is cold enough for frost, so crops must be harvested before frost is likely.

Very high daytime temperatures (above 37°C) can slow down crop growth and cause moisture stress in the hottest part of the day, even in well-watered crops. Peanuts have a higher rate of fruit set and better pod development when soil temperatures are less than 30°C in the top 5 cm.

9.5 Agronomy.

9.5.1 Cultivation.

Currently conventional tillage is the most common method of land preparation. The benefits of minimal tillage are well documented (Choudhary, 1993). However it will require further research to optimise peanut production (Ham, 2004).

Sandy soils may benefit from use of a “green manure” cover crop as part of the rotation. This is incorporated in the early spring to allow for breakdown of the large amount of organic matter produced. Final seedbed preparation can begin in late spring provided the ground is well drained and trafficable. The incorporation of large amounts of mulch assists with soil structure, fertility and weed control (Ham, 2004).

Planting on mounds or forming beds is a matter of choice. In some situations mounds are required for drainage purposes and to facilitate digging. In light soils this is less critical. In the initial year of cropping, it is important that the area be cleared of all sticks, stones and stumps. Such material will damage digging and threshing machinery and can cause delays in harvesting and reduction in yield. The land should be levelled to facilitate consistent depth control at digging. For these reasons, peanuts are not generally recommended in new paddocks.

9.5.2 Planting.

A consistent and evenly established planting is the foundation for a successful crop. Attention to detail is extremely important during planting. This is achieved by minimising seed damage as the seeds are very delicate and can split easily, most Agronomists use the saying "Handle like eggs". Planting depth should be at least 5 cm. Ensure good seed to soil contact and adequate soil cover over the row. Adjust depth to suit moisture conditions. Use irrigation (if available) to pre irrigate soil, ensure the soil is moist to 40 cm initially. If dry conditions are unavoidable plant deeper (up to 8 cm maximum). Seeds should be planted at between 12 and 18 seeds per metre. Plant at the high rate for irrigated situations and the lower rate for dryland farming. Established populations should be between 100,000 (dryland) and up to 160,000 (irrigated) plants per hectare. Standard row spacing is 90 cm. Row spacing can be as narrow as 75 cm. However most harvest machinery is designed for a 90 cm row spacing.

Precision vacuum drills are needed to plant peanuts, standard maize drills can be used if modified or peanut disks are inserted to the seed metering wheels.

9.5.3 Weed Control.

Weeds not only compete with the crop for moisture, nutrients and light, they can also cause major problems at harvest and reduce the quality of the crop. Weeds also reduce the effectiveness of fungicide applications because some of the fungicide falls on the weed instead of the peanut foliage. This section is based on information from the Peanut Company of Australia's Best Management Practices (DEEDI, 2007), with only chemicals available in New Zealand being included.

Early control of weeds in peanut crops is critical. Weed control in the crop starts with the seedbed preparation as peanuts do not compete well for the first six weeks. Peanuts usually maintain the yield potential if the grower eradicates weeds within the first three to four weeks after planting and the peanut crop remains weed-free for the rest of the season. Yields will generally suffer if weeds remain in the crop during the four to eight weeks after planting.

A combination of cultivation and herbicides is usually needed to control weeds in peanuts, although in irrigated or high rainfall crops weeds are usually controlled with the use of herbicides.

Grasses are usually controlled before planting with an incorporated herbicide such as trifluralin or pendimethalin. Imazethapyr (e.g. Spinnaker). Dual applied post-plant pre-emergence controls some grasses. Fluazifop-p (e.g. Fusilade), Sertin, quizalofop-p-ethyl (e.g. Targa) and haloxyfop (e.g. Verdict) will control grass 'escapes' after crop emergence. Paraquat will only control very small grasses. Glyphosate provides useful fallow weed control and good pre cultivation weed knockdown (DEEDI, 2007).

Basagran, Blazer, Buttress, Paraquat, imazapic (e.g. Flame) and Imazethapyr (e.g. Spinnaker) are the main controls available for broadleaf weeds.

Basagran will control many broadleaf weeds, however, it will not control wild gooseberry or sesbania. Use Blazer if these weeds are present. Using Basagran or Blazer in the middle of the day may result in poor weed control. Spraying may need to stop by 9 to 10 a.m. Even irrigated crops can have stressed weeds in the middle of the day depending on the evapotranspiration on that day.

Paraquat gives cheap, effective control of several common weeds. Although it can scorch peanut leaves, they do recover rapidly. The peanut crop should be sprayed before the 7 to 8-leaf stage. Good coverage is essential. Unlike Basagran and Blazer, paraquat will control stressed weeds, but they usually must be at less than the 4- leaf stage. Many growers mix Basagran with paraquat to reduce the burn on the peanuts that can result from using paraquat on its own.

Dual is sometimes banded over the row at planting to control wandering jew (Commelina benghalensis). Unlike trifluralin, Dual does not need mechanical incorporation, but it does need rain or irrigation within ten days of application. Prometryn provides good control of many weeds in irrigated peanuts. Its cost and the need for moisture makes it unsuitable for dryland peanuts, except in high rainfall areas.

Rope wick-weeders with glyphosate are used to control large broadleaf weeds, Johnson grass (Sorghum halepense) and volunteer maize and sorghum.

Volunteer peanut plants growing in other crops and in the fallow between crops are very difficult to control. Many herbicides and combinations of herbicides will severely distort peanuts, but may not reliably kill them.

Fallow sprays of glyphosate up to 2 L/ha and Sprayseed have not killed all volunteer peanuts even when used in combination with other herbicides, such as 2,4-D amine, dicamba and atrazine. Herbicides used in rotation crops of sorghum and maize do not always give reliable control of volunteer peanuts. Combinations of atrazine and Starane have proven the most effective.

In fallow paddocks use glyphosate, 2,4-D amine, dicamba, atrazine and Starane to control grasses, broadleaf and woody weeds.

9.5.4 Pests and Diseases.

9.5.4.1 Pests.

Peanuts generally have fewer above-ground pest problems compared to other high-value crops. In traditional peanut growing areas, foliar pests usually do not cause major economic damage. However, soil pests can cause major economic damage. The worst damage usually occurs where there is a long history of peanut growing with few non-legume crops in the rotation. Most other pest problems only occur occasionally. This section is based on information from the Peanut Company of Australia's Best Management Practices (DEEDI, 2007), with only the most common pests being summarised.

During vegetative growth, damage is mainly due to foliage by either leaf-chewing or sap-feeding pests. Sap-feeding pests include lucerne and vegetable leafhoppers (jassids), peanut mites and aphids, and may occur any time after crop emergence. Peanut mites can damage peanuts during prolonged dry periods. The mite disappears with rain and the plant outgrows the damage. The two-spotted mite is not normally a pest of peanuts. However, if peanuts are sprayed heavily with non-selective (hard) pesticides, or are grown in areas where adjacent crops are heavily sprayed, then two-spotted mite infestations may occur. In the vegetative stage, control action may be required if the pest is still present and more than 10 plants out of 30 have more than 30% reduction in leaf area.

Sap-sucking pests present in the vegetative stage can continue into flowering, pegging and podfill. Mirids may also affect the crop, feeding on buds and flowers and causing them to abort.

Aphids are common. They are not considered a pest However, they are vectors of the peanut mottle virus. Peanut mottle virus is usually not a problem in peanuts, but can be a major concern in navy beans growing nearby. Registered chemical: Dimethoate as a foliar spray.

Cutworms (Agrotis spp.) cause minor and sporadic damage. Seedlings are chewed off around ground level. Damage is usually patchy and tends to progress outwards from the initial damage site. Registered chemical: Chlorpyrifos.

Leafhopper, vegetable (Austroasca viridigrisea) can be a minor to frequent problem. Vegetable leafhopper is emerald (blue-green) in colour. It is very common in most peanut crops. Damage is caused by Nymphs and adults sucking the contents of leaf cells. The leaf cell dies, leaving a white spot. Adjacent spots form the stipple pattern. Damage is worse when plants are stressed. Vegetable leafhoppers usually dont not need control, except where there are extremely high populations during hot dry weather. Registered chemical: Dimethoate as a foliar spray.

White-fringed weevil (Graphognathus leucoloma) can cause significant damage. Larvae chewing into the taproot cause the most damage. This results in severely reduced vigour or the death of the plant. Pegs can also be damaged and mature larvae will chew the developing nut. Infestations in a crop are usually patchy. Adults will chew leaves and may cause patchy seedling stands. Root damage from larvae may allow cylindrocladium black rot (CBR) infection. Registered chemical: A maximum of four foliar sprays of methamidophos (e.g. Monitor or Nitofol) directed at the adults. Cultural control of White-fringed weevil can be effective by reducing larvae carry-over from the previous season's crop by removing volunteer peanuts from maize to reduce the carry-over of larvae in the soil. Also avoid planting on land planted to or adjacent to peanuts or lucerne in the previous season and reducing the frequency of legume and tuber crops in the rotation to help reduce populations. For example, avoid planting potatoes after peanuts.

9.5.4.2 Disease.

Peanuts are affected by a range of foliar and soil-borne diseases that can have a large impact on yield and quality. Management, such as crop rotation and the use of fungicides, can minimise the effect of most of these. It is common to see some peanut plants dying throughout the season from a range of causes. But it is only when the plant population is significantly reduced that concern should be raised. This section is based on information from the Peanut Company of Australia's Best Management Practices (DEEDI, 2007), with only the most common diseases being summarised.

Crop rotation can have a significant impact on many diseases. For example, where one peanut crop follows another, seedling diseases are generally more common and leaf spot will appear earlier and be more severe. Peanut diseases spread into new peanut growing areas in many different ways. Rust spores can blow on the wind for long distances, while leaf spot spores travel for shorter distances. Equipment, particularly diggers and threshers, can spread soil-borne diseases. Some diseases are already present in almost all soils, with Aspergillus flavus (the aflatoxin-producing fungus) a good example. In many environments, a fungicide program is needed to control foliar diseases such as leaf spot and rust.

This may involve between two and ten sprays, depending on district and season. In more humid areas and coastal areas, foliar diseases are a greater problem. Diseases can be divided into categories depending on when and how they attack the peanut plant. Some alternative causes, such as seed damage, are also included.

To achieve high yields, growers must control leaf diseases. The timing of fungicide sprays will depend on the disease incidence in the region. For example, inland irrigated areas do not have the same disease pressures that exist in coastal areas. In areas where diseases are always present and disease pressure is almost always severe, it is critical that early protectant fungicides are applied as early as 21 days after the crop emerges. The fungicide program should continue until just before digging.

Soil-borne fungi including Aspergillus crown rot (Aspergillus niger) and Rhizopus arrhizus can cause widespread damage and can be serious, causing low plant population or creating large gaps in the stand. Remaining plants may not compensate. Symptoms include the seed not emerging, or seedlings dying. Fungal growth on the seed may or may not be present. But soil-borne fungi are already present in all soils. Management strategies include chemically treating seed with a recommended fungicide. Cultural management includes planting seed into warm soil (above 18°C) and not planting if weather conditions are likely to cause soil temperature to fall below 18°C or rise above 50°C. Planting too deep will increase the risk of seedling disease.

Damaged seed has a similar effect to soil-borne fungi, except the losses are not likely to continue after emergence; Remaining plants may still show poor vigour. Management of seed damage is to check and maintain planting equipment to minimise damage to seed. Handle seed carefully and select seed from crops which have not been affected by drought and have been cured slowly.

Early and late leaf spot (Cercospora arachidicola and Cercosporidium personatum) have a major effect in most peanut areas. Favoured by high rainfall and sprinkler irrigation. Damage includes leaves falling off and stems and pegs are weakened if the epidemic starts early, is uncontrolled and weather conditions favour disease spread. Conditions favouring rapid peanut growth also favour the spread of leaf spot. Leaves must be wet from rain, dew or irrigation for long periods to trigger infections. Crop potential is reduced when infected leaves fall off. Harvesting losses increase as infected pegs lose strength and break during pulling and threshing.

Symptoms include small, dark spots become brown to black on both sides of the leaf as they enlarge up to 10 mm. There may be a yellow halo around the spots. Spots appear on the lower leaves first, but are not visible for 7 to 10 days after infection. Masses of spores are often seen on the underside of the leaf. Stems and pegs also become infected. Spores are spread mainly when dew dries off in the morning or when rain starts.
They do not spread over long distances, so infections will often start from infected crop residues. The fungal spores are spread by wind and rain. However, as the residue of previous peanut crops is the main source of inoculum, peanuts following peanuts are often the most heavily affected.

Both diseases can be controlled by the same fungicides. In high rainfall areas and for irrigated crops, a spray schedule of 10 to 14 days is needed. Leaf spot increases rapidly during warm, wet weather and irrigation. Fungicides also break down more quickly under these conditions and a shorter interval between sprays must be used to protect new foliage.

Some fungicides only provide protection, while others can control infections which take place three to six days before application. These eradicant fungicides will not control well established infections. Spray up to four weeks before harvest. When choosing fungicides, consider other diseases in the crop and whether the crop will be baled for hay.

Total prevention is not possible. Peanut volunteers on headlands and in rotation crops can carry the diseases between crops and should be destroyed. Avoid peanut to peanut rotations. It is recommended to sow the Sutherland variety because it is resistant to leaf spot.

Rust (Puccinia arachidis): Damage can cause major crop losses if it starts early and is uncontrolled. Once rust starts in a crop, dews and fogs are sufficient to create a serious epidemic.

Symptoms include small, yellow spots that quickly produce typical ‘rusty’ spores. Spores are not visible for 7 to 10 days after infection. They are usually found underneath the lower leaves and spread very rapidly. Infections are often first found as a ‘hot spot’ with a few plants covered in rust.

The spores can blow long distances between crops. Management strategies include spraying with a fungicide until the crop is within two weeks of harvest. A spray program similar to that for leaf spot may be needed. Consider other diseases which may be in the crop.

Rust spores cannot survive for very long without living plants, so destroy volunteer peanut plants between crops, especially on headlands, contour banks and around buildings. There are no known alternative hosts for peanut rust.

Net (or web) blotch (Didymosphaeria arachidicola). Generally minor but can flare up in some years. Causes rapid defoliation (and subsequent yield loss) during cool, showery weather. Symptoms include a network of very fine brown lines develop on the top surface of the leaf. These join together to form brownish blotches which may go through the leaf.

The fungus survives on peanut residues from the previous season. Management strategies include spraying as soon as symptoms are seen during cool, showery weather. Not all fungicides control net blotch. Spray programs for leaf spot and rust protect against net blotch, provided appropriate fungicides are used.

Net blotch epidemics are difficult to predict, but irrigation may create ideal conditions for infection. It may be necessary to adjust irrigation practices. Spanish varieties are more susceptible than Virginia types.

Aflatoxin-producing fungi (Aspergillus flavus and A. parasiticus) is major and widespread, particularly in dryland crops. Kernels contaminated with aflatoxin bring a reduced price and, in cases of very high levels, may be downgraded to oil quality.

High soil temperatures and drought during flowering and podfill are the major causes of aflatoxin contamination. Pods damaged by insects, disease or rain after a dry period or after harvest allow the fungus access to the kernels. A. flavus develops most rapidly between 25°C and 35°C when pod moisture is 14 to 35%.

Symptoms of the greenish-yellow fungi are not always visible in harvested kernels. The toxins can only be detected in a laboratory. Management strategies include irrigating the crop to minimise the risk of pre-harvest aflatoxin. However, if the plant is allowed to stress just prior to maturity, the A. flavus mould can still invade the pod.

Dig as soon as the crop is mature. Leaving peanuts in the windrow to dry to 13% moisture increases the risk of aflatoxin because of the chance of rain re-wetting the crop. The risk is much higher if the plants were moisture-stressed before harvest. Peanuts in well inverted windrows have a lower risk because they dry quicker

9.6 Harvest.

9.6.1 Harvest Maturity.

The peanut is an “indeterminate” plant. This means that the flowering and fruiting of the crop occur over a long period of time. Flowering is not closely correlated with environmental triggers such as day length. Therefore the assessment of maturity can be difficult. Determination of maturity is critical in the harvesting process and requires close observation by the grower. The current method employed is to hand dig and shell a sample of peanuts (about 300 pods) and observe the darkening of the inside of the shell. When at least 60-75% (depending on the cultivar) of the pods are a dark brown inside the shell, the crop is ready to dig (Ham, 2004).

The shell out method involves cracking open or 'shelling out' all the pods from the sample plants and assessing the colour of the seed coat and inside the shell. Peanut pods of varying maturity can have similar outward appearance.

As the kernels mature, the seed coat changes in colour from white to a dark pink (or red for Spanish types). Crack each pod open and examine the inside of the shell and the kernel. Sort the pods into the following categories: Immature – seed coat is white and fleshy with no colouring inside the pod. Intermediate – seed coat is light pink with slight colouring inside the pod. Mature – seed coat is dark pink or tan, thin and dry with dark colouring inside pods.

The time to dig depends on the percentage of pods in each category. As a guide, consider digging the crop when the following levels of maturity are reached: Virginia types – 60 to 70 per cent mature Spanish types – 70 to 80 per cent mature Runner types – 65 to 75 per cent mature The shell out method is fairly subjective and time-consuming, but it is a useful way of assessing maturity if no other method is available.

The hull scrape method relies on colour changes under the outer skin of the shell to indicate kernel maturity. Remove the outer skin of the pod (exocarp) to expose the colouring around the saddle. To do this, either scrape the pod with a pocketknife or use the abrasive power of a water and glass bead solution or high-pressure water cleaner.

The colours which occur are: black – mature to over-mature, dark brown – mature, orange/brown – close to maturity, yellow – intermediate and white – immature. Assess at least 200 pods. Place pods in the maturity categories immediately, because the colours will fade rapidly as the scraped pods dry out. If necessary, keep the scraped pods moist using water in a spray bottle.

A severe late-season drought will stop maturation in the brown and black pods. The colours do not show up well in these shells. Break open, rather than scrape the shells of these peanuts to see if bronze-coloured kernels have separated from the shell. Pods in this condition will not gain weight and will easily fall off during the digging operation.

Crop maturity can also be determined using the Growing Degree Day (GDD) number for the variety grown. The current varieties reach maturity at around 2150 GDDs. If shorter season varieties are released, the GDD number for maturity will be considerably less than 2150. Using this model, begin to check the maturity of the crop when the GDD figure reaches 1900.

9.6.2 Digging.

Careful digging is critical to the rest of the harvest operation. A good operator working in a weed-free paddock of soft soil can achieve harvest losses of less than five per cent. The diggers are linkage mounted and cut the taproot below the pods. The machine lifts the bushes from the ground, shakes the soil off, inverts the bushes and lays them in windrows to dry. The cutter blades, which cut the taproots just below the level of the nuts, can be either mid-mounted on a stump-jump framework or attached to the front of the digger.

Losses occur if the blades are run too shallow. Keep the blades sharp and set them to penetrate the soil at the same depth for heel and toe. A slight forward pitch will lift the plants and loosen the soil around them, which will reduce the chances of pegs breaking. Dull blades will not cut the root cleanly and may drag the bush, losing peanuts in the process.

The three main digger types are: Tyre puller – rotating tyres grab the top of the bush and pull it out of the soil after the taproot has been cut, Chain puller – similar to a tyre puller except that parallel chains grab the top and the Elevating digger inverter (e.g. KMC) – cutter bar cuts and lifts the crop onto an elevator system before inverting the bushes. Care is needed with all types of diggers to avoid leaving pods behind. Synchronise the ground speed with the speed of the elevator chains or belts. Peanuts should drop to the same place from where they were lifted. Speeds over 5 km/h may jerk the plants from the soil and cause losses.

Peanuts contain 40 to 50 per cent moisture when they are dug. They need to dry down to 16 to 20 per cent in the windrow, which generally takes 2 to 7 days. Leaving peanuts in the field to dry down to a safe storage moisture of 13 per cent is risky, as damage from rain, birds and over-drying can occur during the 7 to 14 days it takes to dry down to this moisture content. Invert the bushes, making sure the pods do not touch the ground, to ensure rapid and even drying. If it rains before threshing, well inverted crops will dry quickly.

Under very hot conditions, peanuts on the soil surface may develop off-flavours or be more susceptible to damage during processing. Some diggers invert the crop better than others, depending on bush size and shape. Some diggers have inverting rods or rake wheels, but these can mix the windrows up rather than leaving the pods on top and put soil and rocks into the windrow. Rakes are useful in dryland crops for putting several rows into one windrow.

If heavy rain falls and the leaves become sealed to the soil, the windrow may need to be lifted just before threshing. This is called 'fluffing' and the lifting is similar to an elevating digger, but without the inverter.

Pod losses under these conditions can be high, so extreme care is needed when re-working the windrow and it should be done only if absolutely necessary. Spanish varieties are less susceptible to losses when re-worked.

9.6.3 Threshing.

Peanut Threshers are specially built harvesters that pick up the windrow, similar to a hay bailer then gently thresh the pods off the peanut plant, then using airflow, deposits the pods into a tipping bin on top of the machine.

Threshing at high moisture content and then artificially drying the kernels minimises weather damage and is essential for consistent production of good quality peanuts.

Harvest irrigated areas separately from dryland areas. This may mean turning in the middle of a row if the irrigator does not reach the whole paddock. Drought-stressed peanuts on the ends of the row are more likely to have aflatoxin. Mixing peanuts from these ends of rows is a common way to end up with aflatoxin-positive loads from irrigated crops.

Modern threshers will remove peanuts from the bush under almost any conditions. However, the settings on the thresher can affect yield, quality, germination and flavour. Set the thresher to remove all peanuts from the bush without smashing the bush. Excessive action breaks the bushes into short pieces, so that instead of passing over the sieves, they fall through with the peanuts and overload the cleaning screens.

Excessive drum speed has the greatest effect on quality, causing physical damage to the kernels (Appendix 5.0). This effect is much more severe when threshing peanuts at low moisture. Check the settings several times a day, as conditions change.

Air conveyers on the thresher can cause the shells of dry peanuts to crack if the fans are operated too fast or the dampers are not adjusted properly. Use only enough air velocity to lift the peanuts into the bin. The air velocity for the cleaning screens also needs frequent checking and adjustment. Use just enough air to blow trash and pops, but not good peanuts, out of the machine.

Some threshers are modified so the straw is dropped into windrows to make hay baling easier.

Peanuts can certainly be threshed at moisture levels well above 25 per cent, but the extra cost and time to dry the crop may offset any advantage. Also, peanuts threshed at very high moisture content can suffer mechanical damage if the thresher has to operate at very high internal speeds. If peanuts are allowed to dry to below 16 per cent in the field, the pick-up percentage drops and the thresher may damage more kernels. The cost of losing pods and quality during threshing when below 16 per cent is likely to be more than the cost of drying.

Pre- cleaning the load prior to delivery reduces the amount of extraneous material (dirt, sticks etc) in the load. Pre-cleaning removes many of the small immature pods that are high in moisture and so can reduce the overall moisture of a load. Pre-cleaning improves quality and reduces drying and freight costs.

9.7 Processing.

9.7.1 Drying.

Drying peanuts should begin with pre-cleaning to remove soil and should follow strict guidelines for temperature, humidity, airflow and drying depth (Hill, 1999). Quality, and hence high prices, will be maintained by following these guidelines.

There are two main systems of drying peanuts: the truck-back system, and the combination storage/drying system. Peanut quality is maintained when moisture is removed slowly at low temperatures. The market pays more for quality peanuts and actively penalises suppliers of poorer quality peanuts, so drying the crop correctly is well worthwhile.

Unlike many other grain crops, peanuts cannot be dried fast at high temperatures. To maintain quality, the crop must be dried slowly under controlled conditions. Nut-in-shell peanuts store safely when the moisture content is below 13 percent (DEEDI, 2007). Peanuts drier than this tend to split more easily during shelling. The amount of splits increases rapidly as peanuts are dried below 12 per cent moisture. Large seeded Virginia varieties are very susceptible to splitting when over-dried.

Follow these procedures to dry peanuts efficiently and minimise damage (DEEDI, 2007):

- Pre-clean to remove excess dirt. Start drying within three hours of threshing to prevent the development of aflatoxin. Have an even depth of peanuts over the drier floor. The ideal maximum is two metres at this depth, some shovelling may be necessary.
- Remove a maximum of 0.5 per cent moisture per hour.
- Keep the air temperature in the plenum chamber below 35°C and no more than 11°C above the ambient air temperature.
- Use a minimum air flow of 200 L/sec (12 cubic metre/min) per cubic metre of peanuts.
- Keep the relative humidity of the drying air between 50 and 60 per cent.

The in-storage drying system involves drying of wet peanuts in a bin that can serve as either a storage unit or a drier. Some systems use the same bin for drying and storing. Others have one or more drying bins, as well as a number of storage bins for holding the cured nuts.

In these systems, the drying bins may be used as storage if they are not needed for drying. The key to designing and building in-storage drying systems is to accommodate the entire bed of peanuts within the drying zone.

This is done by: supplying air at 200 L/s (12 m3/min) per m3 of peanuts, keeping the depth of peanuts shallow (less than 2 m).

The shallow bed depth also reduces the static pressure that the fan must operate against and this means smaller fans can be used. If more than one bin is being dried at a time, then all bins should have the same bed depths.

The Truck-back drying system design is based on the American system, where drying wagons are used to take the peanuts to a centralised drying plant. The removable truck bins or trailers are designed as a transport bin, a storage bin and a drying bin and can easily be removed from the truck when fully loaded. In this case, the peanuts are dried on farm and then delivered to central storage.

The system operates very well where peanuts can be delivered to the intake immediately after drying. The system loses its advantages where on-farm storage after drying is required, as most farmers have only a limited number of bins. The individual fan/heater packages for each bin allows the size of the system to be more readily modified to suit growing demand than the in-storage multiple bin units.

Drying occurs as air blows through the plenum in the bottom of the bin under the peanuts, traveling up through the shallow bed of peanuts.

9.7.2 Shelling.

At the shelling company or buying station, peanuts are sampled and graded to determine their value. The inspectors establish the kernel content, size of pods, kernel size, moisture content, damaged kernels, foreign material and any signs of fungus. The results of the inspection determine the overall quality and value of each load.

After the peanuts are purchased by the sheller, they are placed in dry storage for eventual sale to processors and manufacturers. At the shelling plant, peanuts are taken from storage and cleaned, where dirt, rocks, bits of vines and other debris are removed. If they are to be sold in their shells, the peanuts may also pass through a machine that cuts off any remaining stems on the shells. To sort for size, the peanuts travel over sizing screens that permit the smaller pods to fall through (VCP, 2012b).

Peanuts to be shelled are placed in slotted drums containing screens of different sizes. Rotating peanuts rub against each other until the shells are opened and the kernels fall out. The kernels are sized on screens that permit the smaller kernels to fall through. The shelled peanuts are cleaned again to remove foreign materials. This is done with density separators, electronic colour sorters and by visual inspection to ensure that only the best peanuts reach the market. The peanut kernels are then sized, graded and bagged for market.

9.7.3 Processing

Peanuts are cleaned again and 'blanched' before they are used in most peanut foods. Blanching is simply the removal of the reddish skin covering the kernels. In whole-nut or split-nut dry blanching, the kernels travel through warm air for a period of time to loosen the skins. Then the kernels go through a blanching machine where large rollers rub the surfaces of the kernels until the skins fall off. These kernels are checked with electronic colour sorters to ensure that blanching is complete. The skins from the blanching process are used for stock feed.

After blanching the peanuts are sold as whole raw peanuts or split peanuts to roasters or other processors. Some processors will have facilities that will process peanuts right from farmers stock right through to the finished product.

Peanuts used for peanut butter will be run through a rubber roller which will split the kernel, then pass the split kernels over a vibrating screen to remove the bitter tasting peanut germ. The peanut germ is collected and sold to pet shops as bird feed or to health shops as a food supplement. After splitting the peanuts are then roasted before grinding into peanut butter.

Roasting involves the kernels being heated either by batch method, where a measured amount or batch is processed at one time or by continuous roasters, where a steady stream of peanuts are roasted continuously through the machine. Most continuous roasters are of the hot air type where the peanuts travel over a vibrating screen with hot air being forced through the peanuts, until the required roast is achieved. Batch roasting is done either by placing the peanuts in an oven or by placing the peanuts in a hot revolving drum for a period of time.

After roasting the peanuts are cooled and further processed depending on the end use and consumer needs.

Crushing of peanuts for oil is mainly gone through a screw press which slowly grinds and presses the peanuts to extract the oil, leaving a dry peanut meal behind which is mainly used as stock feed.

9.8 Peanut Yields.

Peanut yields are highly variable depending on soil nutrient levels and soil moisture levels. Dryland crops will yield between 0.5 to 2.0 tonnes per hectare, compared to irrigated crops which can yield between 4.0 and 8.0 tonnes per hectare (DEEDI, 2007).

New Zealand peanut trial yield results back in 1979 and 1980 showed yields between 1.3 tonnes per hectare and 2.1 tonnes per hectare (Anderson, 1981).

In good growing conditions yields of over 4.0 tonnes per hectare have been recorded in the Kaipara (Griffiths, 2003) with consistent yields of 2.5 tonnes per hectare being achievable in Northland.

10.0 Northland New Zealand.

10.1 Climate.

Northland is known for its warm humid growing climate. The average rainfall is between 1300 and 1800 mm (Figure 3.0, Appendix 2.0) meaning that local farms are relatively summer safe and do not require irrigation. Summers are relatively warm and humid with winters being cool and wet. Most of the rainfall is spread over the early autumn to late spring. Rainfall throughout the summer is sporadic and summer droughts can occur. Frosts are not common with only two frosts occurring in the last five years. The prevailing wind is a westerly wind with cold fronts coming from the south.

Figure 3.0 Kaitaia average rainfall 1981 – 2000 (Trafford, 2011)

Kaitaia Rainfall Averages 1981 - 2000 (mm)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year
79	88	80	103	110	151	158	140	124	91	92	96	1308

The average temperature stays fairly consistent throughout the year at 15.4 °C (Figure 4.0. Appendix 1.0). This is due to the mild winters. Pasture growth is slowed through the winter months and growth is achievable throughout the winter as soil temperature remains at 10°C or above (Figure 5.0).

Figure 4.0 Kaitaia average air temperature 1981 – 2000 (Trafford, 2011)

Kaitaia Temperature averages 1981 - 2000 (°C)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
19.3	19.8	18.4	16.5	14.5	12.6	11.9	11.8	12.9	14.1	15.7	17.7	15.4

Figure 5.0 Kaitaia average 10cm soil temperatures 1951 – 1980 (Trafford, 2011)

Kaitaia Average Soil Temperatures (10 cm depth) 1951 - 1980 (˚C)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
18.9	19.1	17.8	15.2	12.5	10.8	9.6	10.1	11.5	13.8	15.4	17.4	14.3

The Northland climate would be suitable for growing peanuts with little need for irrigation, although the lower soil temperatures would mean crop maturity would be delayed. Sowing of earlier maturity crops would work best for the Northland climate. Early maturing crops would also avoid the risk of rain during harvest in the autumn, which can delay digging or damage the kernels prior to harvest (Ham, 2004; DEEDI, 2007).

10.2 Soils.

Northland has a wide range of soils, from free draining sandy loams to recent deep peat soils, with the majority of the soils being poorly drained heavy clays.

The areas identified for peanut production are deep sandy loams, volcanic basalt soils, peaty sandy loams and silt loam soils.

There are 2,470 hectares of these soils available in Northland, with only 2,000 hectares of these soils are recommended for peanut production. The soils identified for peanut production have good fertility, drainage and favourable topography. The main limiting factors of Northland soils are steep topography, poor drainage, stones and low pH values restricting production.

Topography has the largest impact on the soils available to grow peanuts. Steep slopes and undulating ground is not favourable with harvesting equipment and harvest losses would be high, resulting in crops that would be uneconomic for the farmer (Griffiths, 2003).

With Northlands soils being predominately clay based, causing poor drainage has a big impact on crop yields. Heavier soils hold more water and can have lower soil temperatures for extended periods which can delay crop maturity and create higher disease and fungal issues (DEEDI, 2007). The extra sprays required to get these crops to maturity increase growing costs, reducing the profitability of the crop. Poor drainage can become an issue at harvest when lifting and field drying crops which can cause crop losses or reduce crop quality, incurring crop penalties (DEEDI, 2007).

Stones on some of the fertile clay loam river flats restricts some production capability. Stoney soil can interfere with the peanut pegs entering the soil, and can cause damage to digging and harvest equipment. Volcanic rocks also prohibit some of the fertile volcanic soils around Okaihau being utilised for peanut production, due to the high cost of clearing the rocks and the potential damage to harvesting equipment.

A large area of the peat soils are unsuitable for peanut production because of low pH values (Griffiths, 2003). With peat soils consisting of large amounts of organic matter, as the organic matter breaks down fluvic acid is produced which lowers the pH making the soil acidic. Also with the soil microbes breaking down the organic matter nitrate is produced which is acidic and can add to the low pH problem, along with other environmental issues.

The pH on peat soils can be remedied by adding lime to the soil, but the amount of lime needed to bring the pH into the required range may not be a financially viable option (Griffiths, 2003).

Nutrient issues can become an issue with low pH soils where aluminium and manganese toxicity, which impedes taproot development and stunts plant growth (DEEDI, 2007).

10.3 Opportunity for Northland.

There is the potential to grow peanuts over much of the low elevation parts of Northland. Areas with the best potential are near Taheke and Otaua, the area from Rangiahua to Okaihau, along the Kaihu River north of Dargaville, on the Wairoa River plains, on the west coast between Baylys Beach and Glinks Gully, areas around the Hikurangi swamp, sandy peat between Ruakaka and Waipu and the area around Lake Humuhumu. These potential growing areas are shown on Appendix 6.0.

The potential to grow peanuts offers an opportunity not only for farmers to diversify their farming operations and spread risk, but also gives the opportunity to produce a niche product that can attract a premium.

Pics peanut butter and Fix and Fogg have shown that small processors can produce a product that is demanded by consumers and fetches a premium on the market.

There is the opportunity for a processing plant to be established in the mid north to work alongside growers to produce a premium branded New Zealand product. Building a brand around the story of New Zealand grown peanuts will give the opportunity to create value from a locally grown sustainable product.

Building a good brand around the product also gives the opportunity to support the local community and economy by creating jobs and supporting local businesses around the new industry.

11.0 Opportunity for Carter Family Whirlwind Trust.

11.1 The Carter Family Whirlwind Trust.

The Carter's farm is owned by the IR Carter and Carter Family Whirlwind Trust and is located at Opononi on the south side of the Hokianga Harbour. The total area is 564 hectares of which 394 hectares is effective under pasture with another 20 hectares planted in exotic forestry with the majority of this in *Pinus radiata*. The remaining 150 hectares is covered with native bush, Manuka scrub and gorse.

The farm has been classified as hard hill country by Beef and Lamb NZ, with some easy rolling hill country. The property has good access throughout the farm allowing a reasonable percentage of the farm to be cultivated. The farms predominant pasture species is Kikuyu, a sub-tropical grass with a rhizomatous spreading habit. Subdivision over the last five years has increased pasture utilisation and productivity to a point where most stock are finished on the property. The farm has some areas which are too steep for vehicles, which tend to be in a constant state of scrub and gorse regeneration.

The current stock policy on the Carter's property is sheep and beef, with the property wintering 4650 stock units. Each year 400 breeding cows are calved and a range of finishing cattle including the farms own progeny and an extra 200 mixed sex weaners are finished and sold prime to the meat companies. The farm also runs 500 Romney breeding ewes, of which all of their lambs are reared and finished on the property.

11.2 Soils

The soils on the property are weakly to moderately leached yellow brown earths. The two predominate soil types on the property are Omanaia Clay Loam and Waiotira Clay Loams.

The Waiotira Clay Loams are situated on the northern half of the farm and cover the largest proportion of the farm. The Waiotira soils on the property have a sand stone parent material (PM) and on the hill country are prone to tunnel gulley erosion. This erosion of the sub soil is controlled with poplar tree plantings to stabilise the ground.

The Omanaia Clay Loams are located on the southern side of the property and have a Limestone PM. The Omanaia series soils are fertile soils with a large cation exchange capacity derived from the Limestone PM. These soils are prone to slipping due to the contour, high clay content and high water content especially during prolonged water logging during winter.

11.3 Area and opportunity.

The land area suitable for peanut production on the Carter family's property is limited by steep topography and poor drainage issues. The land area that would be suitable for peanut production would only total 10 hectares. With the land area identified being highly productive land, a budget would need to be done to see what land use is going to be more beneficial to the farming operation.

Two opportunities present themselves to diversify the farming operation. Option one is to lease land around the farm at Whirinaki and Koutu to grow peanuts, with crop residues from harvest being bailed to produce peanut hay for feeding to livestock over the wet winter period. Producing hay off the farming platform will make more land available for livestock production during the spring and summer, while still allowing the Carters to hold capital stock over the winter.

The second opportunity is to purchase peanut lifting and threshing machinery to have control over our own crop harvest and to provide a professional harvesting option to other growers where owning their own harvesting equipment is prohibitive.

12.0 Conclusion

Peanut production has been explored within New Zealand in the 1980's with good yields of 2.0 tonnes per hectare being achievable. Yields of 4.0 tonnes have been recorded in the Kaipara, proving that peanut production is viable in Northland.

Agronomy knowledge from American and Australian research institutes give good information on best management practices, along with crop pest and disease management which make identifying and controlling problems easier, to achieve the best yields we can.

With some investment in machinery and equipment being needed I can see peanuts as a viable crop option for Northland farmers.

With niche New Zealand peanut processors building unique brands and producing high quality products that are attracting a premium in the local and international market, there is an opportunity for a peanut Shelling and processing facility to be built to supply a premium product to the market.

For this to happen there will need to be some capital spent to build a processing site to service the growers and produce a saleable product that consumers are prepared to pay a premium for.

It is in my view that a peanut industry could be a viable business for both growers and processors in New Zealand.

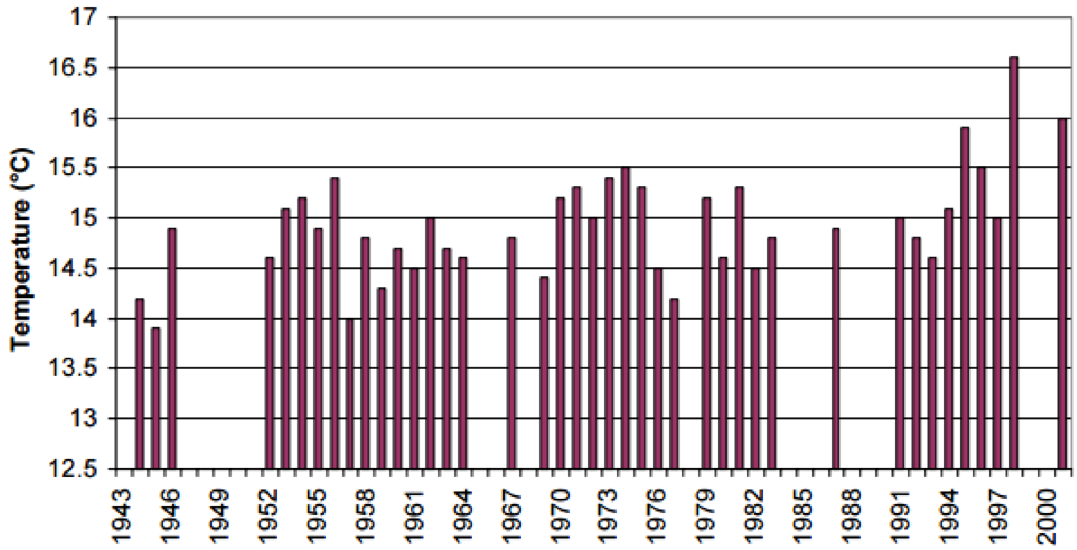
13.0 Next Steps

The next steps needed to confirm the viability of a peanut industry in Northland are:

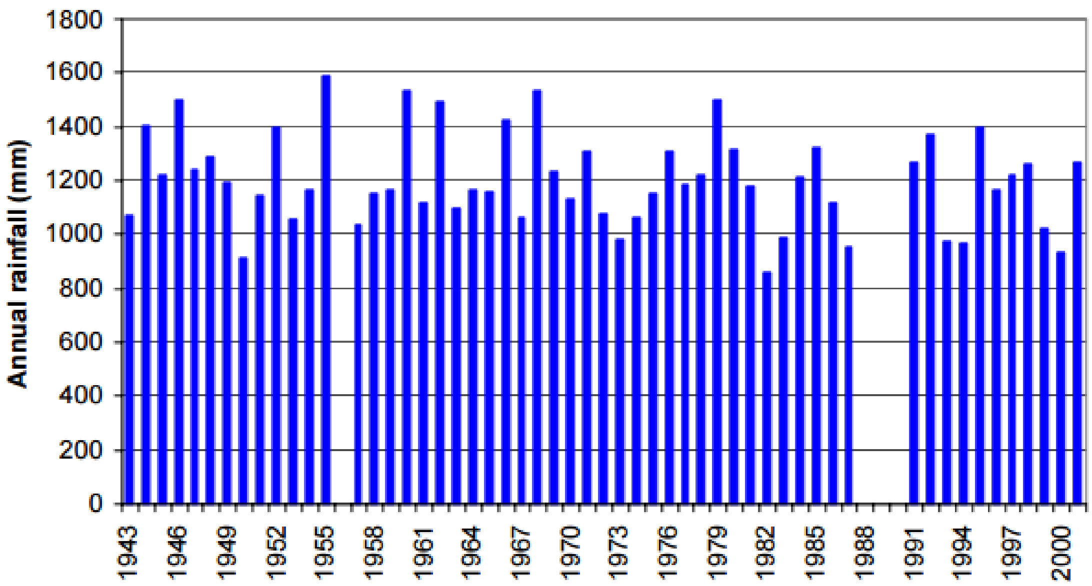
- Run an advanced yield trial to confirm crop yields on a variety of soil types and to explore the best cultivars for Northland conditions.
- From the cultivar yield trial, use the information to calculate the possible returns for farmers and compare this with other farming operations.
- A study into market opportunities and consumer demand for both domestic and export markets.
- A business Case and Business Plan would need to be completed to validate the financial sustainability of the industry and the market.
- Seeking funding and/or investment into building infrastructure for the industry to process and harvest the crop.
- Seek growers to grow and produce the peanut crop.
- Investment into research, development and extension to foster and sustainably grow the industry.

14.0 Appendix

Appendix 1.0 Mean annual temperatures measured at Dargaville from 1943 to 2001 (Griffiths, 2003).



Appendix 2.0 Mean annual rainfall measured at Dargaville from 1943 to 2001(Griffiths, 2003).



Appendix 3.0 Approximate Macro-nutrients required for peanut production on two soil types (Ham, 2004).

Nutrient	Sandy soil, kg/ha of nutrient required	Clay loam soil, kg/ha of nutrient required	Fertiliser options to supply nutrient
Phosphorous (P)	50	40	Super phosphate (single, double, triple). Custom blends available with K.
Potassium (K)	60	40	Muriate of Potash. Potassium sulphate. Custom blends available with P.
Sulphur (S)	40	10	S is supplied by single super, gypsum and other sulphated compounds. Unless S levels are very low (less than 1 mg/kg) these products should provide adequate levels of S.
Calcium (Ca)	150	50	Gypsum. Dolomite.
Magnesium (Mg)	7.5	1	High rates (>2 kg) use Granomag. Low rates (<2 kg) use Magnesium sulphate. If dolomite is used for Ca then additional Mg fertiliser will not be required.

Appendix 4.0 Suggested Micro-nutrient levels for two soil types (Ham, 2004).

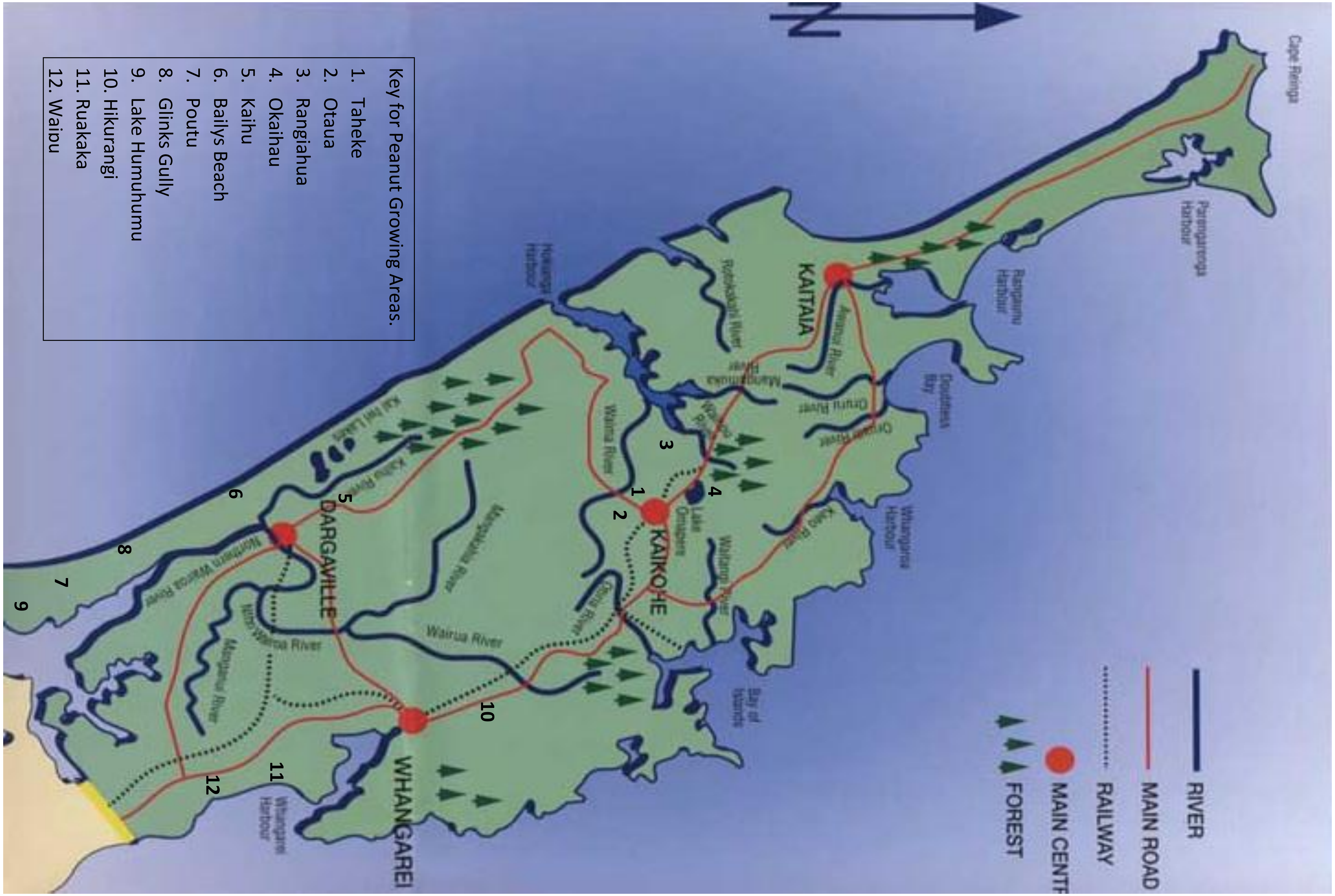
Nutrient	Sandy soil, kg/ha of nutrient required	Clay loam soil, kg/ha of nutrient required	Fertiliser options to supply nutrient
Zinc	4	0.5	Zinc mono hydrate (not suited to foliar application). Zinc Chelate. Zinc hepta hydrate.
Copper	4	0.5	Copper sulphate. Copper chelate.
Manganese	1	Not usually required	Manganese sulphate. Manganese chelate.
Molybdenum	0.3	Not usually required	Sodium molybdate.
Boron	1	0.3	Solubor.
Iron	1	Not usually required	Iron sulphate. Iron chelate.

Appendix 5.0 Effect of thresher cylinder speed on shell damage, loose shell kernels (LSK) and germination.

Cylinder speed	Hull Dammage (%)	LSK (%)	Germination (%)
Slow	17.1	2.6	80
Medium	24.6	3.3	74
Fast	33.4	5.4	65

Source: Producing high quality seed peanuts, 1990, The University of Georgia College of Agriculture, US

Appendix 6.0 Map of Northland Showing suitable growing areas for peanuts.



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