Pristine Forage Technologies

Building the Future.

Productivity Commission;
Enquiry into drought support.

Comments on the Draft Report.

Submission on behalf of Pristine Forage Technologies Pty Ltd

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Overview

Pristine Forage Technologies welcomes the proposed changes in policy direction forecast by the federal government. We believe that they are overdue. They do strongly reflect Pristine's own views of the necessity to encourage self-reliance in broad acre agriculture in general; those views being based on decades of working with farmers and agricultural industries in both public and private sector settings.

We are also in very strong agreement with the directions and supporting recommendations indicated in the draft report of the Productivity Commission, but believe that they would benefit from inclusion of more specific detailed information and recommendations on issues relating to sustainability and farmer adjustment to drought and climate change (Draft Recommendations 7.1 and 8.1 *et seq*.).

No matter how good the policy, if it is not implemented successfully, then it is a waste of effort. That needs to be said, because we believe that in the current circumstances, the changes proposed will fail to be implemented adequately, or effectively, or in time to prevent major damage to agriculture. It is our very specific experience that the current barriers to adoption of critical changes needed are huge and very well entrenched, and that overcoming them will require fundamental, industry-wide revolution, rather than expecting any simple adjustment at the coal face of farming and the individual farmer. The farmer can drive that revolution, but a strongly ingrained aversion to change means that there must be some incentive for it, as it is our experience that neither long term system decline driven by current practices, nor even the acute shock of drought are effective triggering mechanisms.

We wish to outline that experience, its relevance to this enquiry and consequent report, the nature of the barriers that will need to be negotiated to successfully implement the new policy directions, and to offer suggestions for mechanisms to trigger transition to the more sustainable and robust farming systems needed.

Summary

Pristine has developed new technologies and systems that have multiple benefits for farmers throughout the wheat-sheep zone and beyond. These are specifically well suited to addressing the manifest challenges now faced by farmers; such as (but certainly not limited to) those posed by rain drought and climate change that are the major focus of this enquiry.

An even greater threat however, and one that is intensifying the negative impacts of climate change, is a critical and now endemic depletion of soil nitrogen; in effect a continuous and growing "drought" of N, brought on by the unsustainable grain crop centric farming practices of the last 20 years. Amelioration of this N drought is essential for successful minimisation of climate change impact.

This N drought can be very effectively countered and remedied by Pristine's technologies and varieties combined, and these are therefore of fundamental relevance for bringing effect to Draft Recommendations 7.1 and 8.1 *et seq.* of the Draft Report in particular. They will build profitability in all years, help farmers survive adverse years unaided, reverse land degradation, increase farming sustainability and enable Australian farmers to survive and prosper from the expected re-emergence of agriculture as a sunrise industry of the 21st century.

These technologies and systems, and their significance to the current enquiry, its aims and Draft Recommendations are described.

Rates of adoption of these vital new technologies have been incredibly slow; in fact so slow that unless accelerated, there is a very high likelihood that vast areas of land will be irretrievably but needlessly degraded and lost to agriculture. Barriers to message extension and technology delivery to the coal face are virtually universal, with rampant vested interests at all levels of industry and a reluctance to change combining to obstruct meaningful knowledge and technology dissemination, and prevent consequent quantum leap improvements to the robustness and resilience of broad acre farming enterprises.

In line with the requirements as outlined in point 2 of the Terms of Reference for this enquiry, these barriers, the reasons for their existence and possible means by which they may be overcome are discussed and presented for consideration.

Key conclusions and recommendations.

Conclusion. (See section 1). The principal effect of drought in broad acre agricultural industries is to dramatically reduce grain crop yields and production. There is comparatively little impact on animal production, as pasture yields are less vulnerable to rainfall shortage. Furthermore, both animals and feed can be traded to minimise drought impact on profitability and output.

Conclusion. (See Sections 2 and 3). There is strong evidence that other factors, in particular dramatically declining soil nitrogen (N) levels are having a serious adverse

effect on farming system sustainability and profitability, and that this is severely weakening farm enterprises and making them far more vulnerable to drought.

Conclusion. (See Section 4). The manifest decline in productivity, profitability and sustainability of current grain crop centric systems, and consequent increasing vulnerability to climate change and drought, can be reversed very effectively with both current and new technologies using rotations with improved legume pastures.

Conclusion. (See Sections 5,6 and 7). The need to change current unsustainable and damaging grain crop centric practices will be hampered by a whole of industry dependence and focus that has grown up around grain cropping, such that adoption of more sustainable practices is already severely handicapped by a combination of;

- an industry-wide reluctance to change,
- off-farm industry vested interests that are very heavily reliant on farmers sowing grain crops, but are not subject to the checks and balances of on-farm crop system or enterprise decline or failure,
- a domination of entrenched and reactionary interest groups (mainly public sector) in R,D&E direction setting and project selection processes,
- a critical, nation-wide lack of support for farming systems R,D&E,
- a consequent serious deficiency of industry knowledge and understanding of longer term (negative) impacts of current farming systems,
- wasteful use of public sector pasture improvement R,D&E resources to develop new pasture varieties with little commercial value,
- a serious shortage of pasture agronomy and direct pasture improvement R,D&E.

Conclusion. (See Sections 8 and 9). If left to itself, industry will almost certainly continue to take the short term views that are responsible for the widespread degradation and productivity decline that is now evident. It therefore falls to government to take the initiative, to provide clear signals to industry as a whole and to drive system adjustment forward in the face of expected strong inertia and a significant undercurrent of opposition. Overcoming that inertia and opposition is pivotal to successful adjustment and will require a multi-pronged approach that is both resolute and flexible. Some of the suggested necessary changes include;

- re-establishment of long term farming systems R,D&E, supported by government and RRDCs
- redirection of current public sector R,D&E resources away from pasture and forage variety development towards agronomic R,D&E to promote adoption of more robust farming systems based on pasture legume rotations.
- a review of governance, direction setting processes and accountability within RRDCs in general and GRDC in particular to improve performance and relevance of R,D&E to longer term industry needs,
- education of industry as a whole to be responsible for taking a longer term approach to farming and accountable for placing emphasis on sustainability,
- short term support such as (partial) rebates for costs of professional advice and for direct costs incurred in initiating farming system improvement (eg for pasture legume seed purchase) to kick-start adoption of more sustainable and stable farming systems.

<u>Recommendation 1.</u> That the Report of this enquiry notes (on page 45 and elsewhere as appropriate) that drought has a disproportionately large impact on grain cropping, and makes specific reference to the lesser impact on animal production, which therefore offers current solutions to assist farm enterprises survive through drought periods.

<u>Recommendation 2.</u> That the Report includes a new subsection in Chapter 2 (either under current section 2.2 or as a separate section) that notes;

- ***downward trends in productivity of wheat-sheep zone farms,***
- ***evidence for these trends and their likely causes (loss of pasture legumes, N drought) and***
- ***consequent falling profitability leaves farm enterprises increasingly vulnerable and unable to respond effectively to any challenge, including that of drought or climate change.***

<u>Recommendation 3.</u> That the sub-section of Chapter 8 section 3 entitled "General agricultural research" (on page 167 of the Draft Report) makes specific note that

- ***research activities are too short term in nature and focus,***
- ***there are serious gaps in long term agronomy and systems R,D&E, such that major degradation of wheat-sheep zone land resources has gone un-noticed,***
- ***relevant public sector resources (particularly in pasture R,D&E) have been (mis)directed in ways that inhibit both private sector activities and industry adjustment to climate change,***
- ***these failures reflect both the tunnel visioned approach of industry vested interests and an incestuous and closed-shop relationship between R,D&E funders (such as GRDC) and the public sector.***

<u>Recommendation 4</u>. That the Report includes a new section in Chapter 8 (suggested title "Technology adoption" or similar, to be placed in or immediately after the current section 8.3) that notes;

- ***the need to address the problem of unsustainable crop-centric farming systems that are common through the wheat sheep zone as part of any effective strategy to improve farmer self-reliance and to adjust to climate change,***
- ***a restoration of N input via pasture or forage legumes is the most widely practical and economical means to restore sustainability and reverse degradation,***
- ***these systems and technologies are already widely available,***
- ***adoption is severely hampered by off farm vested interests and a critical lack of industry knowledge,***
- ***as there are very limited prospects for crop-only solutions to climate change challenges, these same barriers will also severely hamper adoption of most, if not all effective measures to increase farmer self-reliance and adjustment to climate change.***

<u>Recommendation 5</u>. That Draft Recommendation 8.1 be reworded thus;

"Significant public funding should be directed to research, development and extension (with a particular focus on long term farming systems and agronomy) to provide knowledge to assist farmers and industry adopt more sustainable and

resilient systems and to prepare for, manage and recover from the impacts of climate variability and change. Public funding for farming systems and agronomy R,D&E should be matched by GRDC, or by other RRDCs as appropriate."

<u>Recommendation 6</u>. That an additional Recommendation (8.2) be added thus;

"Public funding should be directed or redirected to specific measures to kick-start adoption of less drought vulnerable and more sustainable farming systems, so that farmers and industry are better equipped to survive climate variability. These should include:

- ***a redirection of current public sector R,D&E resources to promote adoption of more sustainable and less drought prone systems and practices,***
- ***support for information dissemination activities relating to farming system sustainability and stability,***
- ***partial rebates for costs directly incurred by farmers for improving farming system sustainability and stability."***

1. Drought impact on pasture/forage/animal vs crop production.

Production within the broad acre agricultural regions that are currently most at risk of climate change is almost entirely based on the growth of annual plants; annual pasture species for grazing (mainly by sheep) and annual crop species for grain production. The impact of water/rain shortage on the growth of these plants is therefore important in considering the impact on the various production options.

Firstly, annuals are usually by far the best production options for severely rain-limited environments because they grow very fast and have higher water use efficiency. They survive drought periods via seed so that shoot growth for seed production is their first priority and they literally grow like there is no tomorrow. In contrast, perennials grow to survive tomorrow's periods of water shortages and other environmental challenge, and therefore put a lot of effort into below ground crown and root growth, rather than into harvestable shoot or seed growth. Thus for example, under ideal conditions in Australia, it takes about 50 mm of rain to grow a tonne of lucerne (a perennial) forage per hectare, whereas a tonne of a similar annual forage species (eg an annual medic) can be grown with about 30 mm. Hence the efficiency of conversion of rainfall into harvestable top growth is far higher in the annual species than in the perennial.

Secondly in annuals generally, about the first 60-70% of water/rain utilised during growth is used to grow a platform for seed production (the vegetative stage), with the final 30-40% used for producing the seed and protecting it as far as is possible from predation/grazing/loss (the flowering stage). Breeding and selection of plants for agriculture have not changed that pattern to any great extent. The vegetative stage thus involves growing and accumulation of large quantities of nutrients, proteins enzymes and leaf area in preparation for the final dash of flowering and seed set. Once the plant commences flowering, the effort goes into growing carbohydrate for the seed, and transferring nutrients from the rest of the plant and into the seed itself.

Hence as a general rule of thumb, the first 70% of rainfall goes to growing plant nutrients such as protein, while the last 30% goes into cannibalising the plant of those nutrients and putting them into the seed. This means that in a drought where plants die from lack of water before all the nutrients are transferred into the seed, there is limited seed production, but the nutrients remain spread through the plant itself.

From a grain crop perspective, this drought effect is therefore clearly disastrous, but from a grazing (or for a forage crop) perspective, most of the nutrients that are necessary for production of a grazing animal are still available, having been accumulated early in the season. Literally, lack of pasture or forage quantity is offset to a greater or lesser degree by the higher feeding quality and value of the pasture or forage grown, and therefore the impact of drought is proportionately much less.

This is an important point, but one that is certainly not widely appreciated even within agriculture, let alone across the wider community. Hence the statement on p45 of the draft report with respect to the impact of drought on broad acre grazing;

"Drought generally reduces pasture growth, which translates to lower meat or wool production"

while perfectly reasonable, is somewhat misleading of what happens in a real situation, as rainfall reduction has comparatively less impact on the growing of nutrients that are the key to production by grazing animals.

All the above is directly confirmed in Figure 3.2 of the draft report (p48, sourced from ABS data). ***This shows that there are massive impacts of drought years on the output from grain crop production;*** for the 4 major drought years listed, production was cut by an average of about 60%. ***In contrast, livestock production value is scarcely impacted at all in these drought years***; in 2006 for example (statistically claimed as the "worst drought in 1000 years") there is *zero* impact on the value of animal production. In all years, cereal production bounces around all over the place following rainfall, whereas animal production follows slow trends that have no discernible relationship to rainfall.

Further, pastures and forages grown on farm are the cheapest source of animal feed, but they are not the only source. Feed and animals can be bought and sold as needed to generate short or long term profit, so that farm enterprises can continue despite droughts, through application of normal business management practices and skills and trading of stock and feed. In the contrasting case of broad acre crop based enterprises, rain cannot be bought or sold to "finish" the grain crop, and a drought cannot therefore be managed or traded through, but only gambled against.

The one "crop" that is not in the high risk category is a forage crop. This is also because the final seed production phase of growth is not important for maximising harvested yield of nutrients. Hence growing a forage crop instead of a grain to feed animals is also a more efficient and less risky use of rain resources. It can also be a bridge between crop and animal production for current grain crop centric enterprises looking to move towards less risky animal production options, as what forage cannot be used directly on-farm can be sold for cash to other animal producers. There is also the option of supplying quality feed to intensive animal industries such as dairying, where these have traditionally grown their own feed with irrigation, but for whom irrigation water is now severely limited.

Hence while drought can be expected to have some impact on profit levels of an animal enterprise, it is not anywhere near as much of a crisis as it is for grain crop production enterprises. Accordingly, from this view alone, inclusion of a significant animal production side to the enterprise is an obvious change to manage drought and climate change risk very effectively for Australian broad acre agriculture.

<u>Conclusion.</u> The principal effect of drought in broad acre agricultural industries is to dramatically reduce grain crop yields and production. There is comparatively little impact on animal production, as pasture yields are less vulnerable to rainfall shortage. Furthermore, both animals and feed can be traded to minimise drought impact on profitability and output.

2. Australian broad acre agriculture; progressive decline.

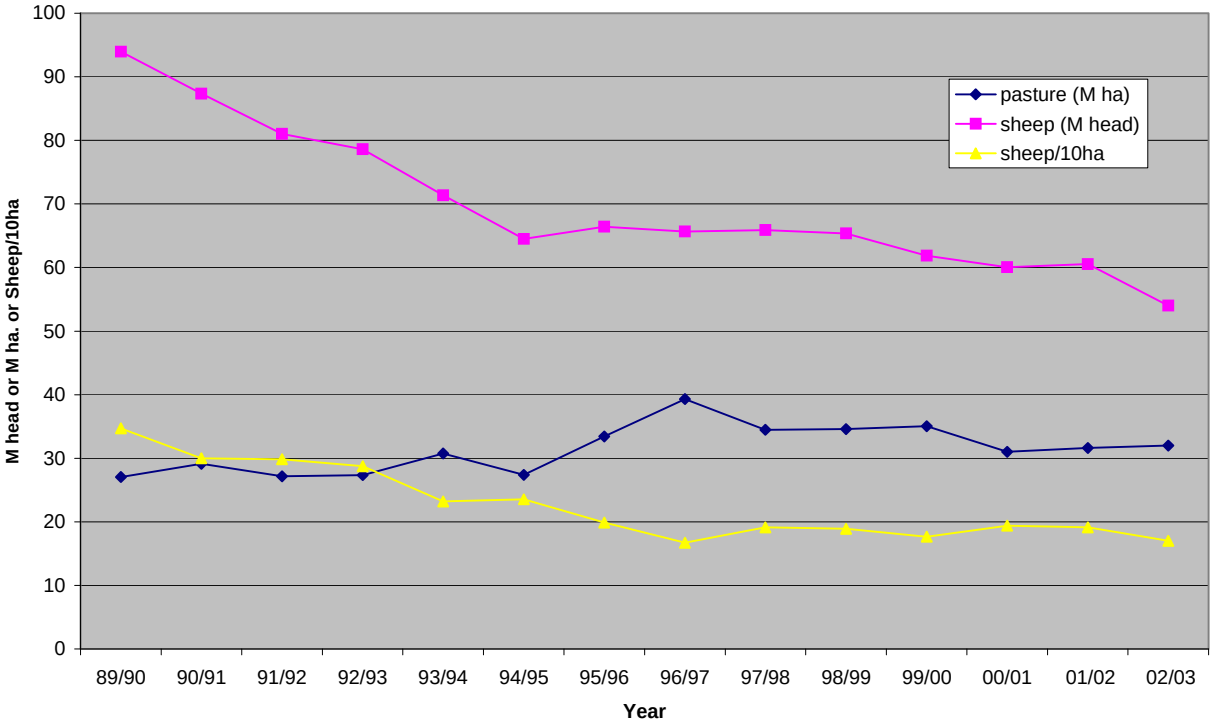
Prior to the most recent droughts, Australia's broad acre farm enterprises were already in serious trouble from another form of "drought"; a soil nitrogen (N) "drought". Just

as a shortage of soil moisture cuts yield, so does a shortage of available soil N, and there has been a constant and increasingly serious rundown (mining) of soil N reserves right across the wheat sheep zone for about 20 years. While N can be replaced to some degree via fertiliser, this is now an insidious and constantly blowing out cost that under the present circumstances is quite unsustainable, both economically and biologically. This lack of sustainability is now translating into depressed yields as well as steeply rising costs.

The N drought finds its roots in a switch from rotation systems of crops with legume based pastures ("ley farming") to grain crop centric rotations and focus from the mid 1980's onwards. This led to the other major facet of the farm enterprise; pasture based animal production, being seriously neglected. The legumes that had previously fixed atmospheric N and supplied it into the farm rotation in sufficient quantities to replace what was being removed with grain progressively disappeared out of pastures, and from then pasture quality and yield also declined.

This was shown by falling stock carrying capacities. ***Wheat-sheep zone sheep numbers peaked at about 95 million in late 1980's, but fell to around 55 M by early 2000's and remain there today, even though pasture area has not declined (Fig 1; data from ABARE).***

Figure 1. Sheep numbers and pasture area, Australian wheat-sheep zone



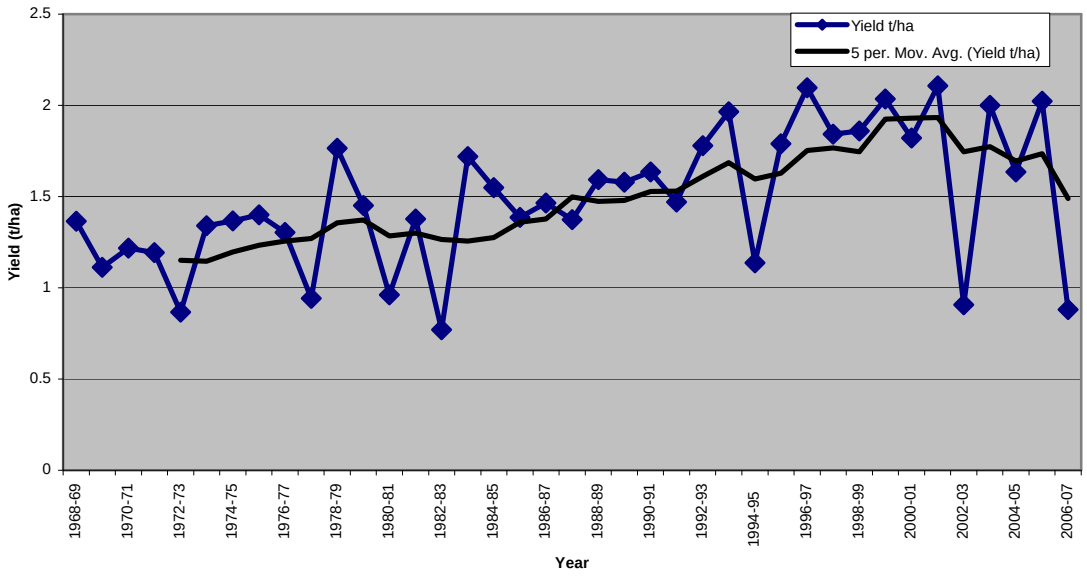
With little or no N input into the rotation system, progressively increasing rates of N fertiliser were needed to try to maintain crop yields. Even so, N was still being mined out of soil reserves, and soil health parameters declined in parallel to N. For example,

there is now considerable evidence that soils are starting to cannibalise themselves to generate sufficient available N to maintain microbiological life.

The fact that these crop centric rotations are unsustainable is reflected in wheat yield trends (Fig 2; data from ABARE). The evidence from the data is that after decades of increasing yields, over the last 15 years these reached a plateau and then began to decline, even before the current drought hit.

What is even more sobering is the fact that varieties used today are about 15% higher yielding than those used at the commencement of the yield plateau about 15 years ago, as confirmed by data from the National Variety Testing Scheme. Without the offsetting effect of these higher yielding varieties, we would have now lost all of the gains of a quarter of a century of agricultural improvement. Had the increasing yield trends of the 70's and particularly the 80's been maintained beyond the middle 1990's, average yields in 2008 would be most likely around 0.4t/ha higher than those indicated by the actual 5 year moving average trendline. Importantly, the struggling farmer himself would capture nearly all of that as profit. That would make a huge difference to the capacity of the farm enterprise to survive all sorts of challenge.

Figure 2. Australian Wheat Yield Trends, 1968-2006



What should be noted is that this yield plateau and decline on the back of declining pasture legume content and system N input was entirely predictable (scientists were warning industry about it in the 1980's) with the only uncertainty being how long it would be before previous steady gains in yield slowed and for the downward trend to emerge. ***Clearly there is now strong evidence of not just a plateau in wheat yields, but also the predicted reversal. Were it not for recently released higher yielding varieties, this "N drought" factor would now outweigh all the painstaking genetic and agronomic advances made over nearly a generation.***

Further exacerbating the situation for the farmer, cereal crop costs have increased dramatically over this period; eg through increasing need for N fertiliser as noted previously. This is now the largest single cereal crop cost, but actual addition is still far less than rate of removal, so that soil reserves continue to decline. For example, if N were added at an average recommended rate in 2008, this would have cost crop farmers between A$600 and A$800 million dollars, but that removed with a cereal crop of average yield would have still resulted in a total N removal/loss of about two to three times the amount added, with the balance coming from this soil N reserve.

Even by the most conservative estimates, to replace the net N mined and removed from our wheat-sheep zone soils via cropping since the late 1980's with fertiliser N would cost at least $A10-15 billion. With the price of this fertiliser rising steadily (and sometimes very precipitately) in real terms, the cost of bridging this "sustainability gap" and overcoming the N drought via this means is now well beyond a farmer's financial capacities.

As this N deficit continues to grow, and soil health deteriorates, we can expect that recovery efficiency of nutrients including N added via chemical fertilisers will fall further, leaving crop farmers with both falling yields and what are already crippling costs continuing to rise geometrically rather than linearly.

3. Comparing impacts of "drought" caused by low rain and low N.

A drought induced by lack of rain is an event that seriously impacts Australian agriculture on average about once in every five to ten years. For the purposes of comparison, we will assume that as a result of climate change, the drought year is not counter-acted by better yields from above average years and the average drought frequency becomes once in every five years. On that basis, the current loss of yield and gross grain crop return in a drought year of about 60% equates to 24 million tonnes of grain, valued at approximately $250/t; for a total of about 6 billion dollars in the year itself or around 1.2 billion dollars annually. (Note that as per above, there is little loss of animal production in a drought year.)

The loss of legumes from pastures in the 1980's and the accompanying rundown of soil N reserves has had the effect of firstly reducing wheat-sheep zone animal carrying capacities by nearly half, and secondly halting and now slowly reversing grain crop yield increases that had been experienced for decades previously. Therefore, had pastures maintained their legume content, we would expect that the wheat-sheep zone of 2008 would be carrying an additional 40-50 million sheep, generating on average 3 - 4 billion dollars of additional production value annually. We would also expect from previous trends that grain crop yields would be on average more than 6 million tonnes higher than at present; this being worth roughly an additional 1.5 billion dollars p.a. at the farm gate. Finally, the current replacement cost of N removed with cropping would be reduced by about 1.5 billion dollars p.a. (We term this the "sustainability gap").

Hence the decline in wheat-sheep zone production today as a result of pasture legume loss and the N drought is valued at about 6 billion dollars per annum; and this figure is increasing with each year as the N drought intensifies. *

Thus comparing the two, it is fair to say that across years, ***while the impact of a rain drought is sudden and therefore very noticeable, the impact of the N drought is far more insidious and profound, and in terms of lost production, on average currently costs wheat-sheep zone farmers about five times as much as episodic drought.***

Dealing effectively with this N drought and its associated problems is thus at least as important for the future of broad acre farming as is dealing effectively with rain droughts. However, it is too expensive to reverse the former with the current technologies and systems (ie using fertiliser N) so that without significant change, the decline in the viability of the now typical grain crop-centric broad acre farm enterprise is likely to continue, and indeed accelerate under the combined pressure of climate change, the continuing decline in soil N reserves, falling yields and geometrically rising costs.

* Note that this does not include other impacts that have resulted from the shift to crop centric rotations and the N drought. But for example, wheat quality (protein content and both price and saleability) has declined dramatically, while costs to control weeds and diseases have also increased.

<u>Conclusion.</u> There is strong evidence that other factors, in particular dramatically declining soil nitrogen (N) levels are having a serious adverse effect on farming system sustainability and profitability, and that this is severely weakening farm enterprises and making them far more vulnerable to drought.

4. Pasture/forage legumes; the means for recovery and survival.

As noted above, the wheat-sheep zone farm has been severely compromised both biologically and economically by the loss of pasture legumes as a source of system N in the 1980's, with severe negative impacts on both cropping and stock enterprise profitability and sustainability. As a result, restoration of legume-based pastures into the system will progressively overcome the N drought over time, and in the process, will double average stock carrying capacity and significantly increase crop yields.

If there is a reason for the "failure" of these ley farming systems beyond the neglect that resulted from the industry wide move to focus on grain cropping, it relates to the difficulty and cost of establishing and maintaining a good legume base in the pasture side of the rotation. These systems relied on survival of legume seed through periods of cropping to regenerate a legume ley pasture without re-sowing when the paddock was "left out" of cropping. Seed set again in that ley year survives through until the next pasture ley phase. However, that persistence of legume requires planning and monitoring of legume seed reserves and making sure that crop and pasture phases are integrated so that the legume is not lost. Hence once the focus went away from the overall rotation and onto the cropping phase only, it was inevitable that the legume disappeared out of the system.

The consequences of overall system productivity (including of the crop) and sustainability decline now being observed are an equally inevitable result of this legume loss. They were predictable, were predicted, and were largely ignored in favour of chasing short-term cash returns from cropping.

It is true that with the low animal returns that characterised the late 1980's through to the mid '90's, the cost of buying seed and re-establishing that legume base was a very significant deterrent. At that time, farmers did not see and/or were not aware of the longer term benefits to the system and only accounted for whatever short term return they could generate from the pasture itself via the animal. With the low animal returns, such pasture improvement was not seen as worthwhile.

Pristine noted this resistance and other predicted trends with respect to system sustainability, N price, climate change, soil N rundown etc. From this, it proactively conceived and developed pasture and forage legume varieties and technologies to address these manifest challenges.

Pristine has developed a suite of high performance, drought tolerant legumes with specific traits to enable cheap on-farm seed production; so that seed can be reliably produced by the farmer himself for as little as one tenth of the cost of buying it. This overcomes the principal problems (legume persistence and seed cost) seen in ley systems. It also advances them to the point where they can effectively and efficiently redress the critical problem of current systems (N drought) and dramatically reduce farm enterprise vulnerability to rain drought/climate change.

Because this on-farm seed is so cheap, good pastures can now be sown and re-sown as and when needed. This opens up a whole range of new and more profitable options for ley farming and a host of variations to make these systems more robust, sustainable, flexible and responsive to both short and long term needs. The capacity to counter climate change far more effectively than is possible even with the successful traditional pasture production technologies is a very significant part of this flexibility and responsiveness.

The absolute importance of these new varieties and technologies in this respect is further underscored by the fact that there have been such significant changes in farm costs, returns and circumstances so that now pasture improvement, even with old legume varieties, is a highly attractive option. Animal returns (eg through sheep meat) have improved significantly and have a strong outlook, and N fertiliser prices are so high that farmers need alternatives right now. As noted above, there are also the huge "hidden" costs of the N drought that can be reversed via pasture improvement with legumes; the yield impacts and the cost of N itself. Hence improvement will rapidly deliver good direct returns from animals to cover costs, while the overall increase in farm profitability from grain crop yield increases, nitrogen savings and those increased animal returns can readily at least double bottom line farm profit, even while the response from increased rotation sustainability and resilience is building.

In summary, these new varieties, technologies and systems hold the major answers sought by this inquiry as quoted in the ToR (p VI in the interim report); to

- ***encourage primary producers and other sections of rural Australia to adopt self-reliant approaches for managing climate change;***
- ***maintain and protect Australia's agricultural and environmental resource base during periods of extreme climate stress; and***

- ***ensure early recovery of agricultural and rural industries, consistent with long-term sustainable levels.***

But further than that, they also represent quantum leap improvements to both short- and long-term profitability of farming for the farmer himself, irrespective of the variations from season to season. [*]

With that being the case, you would very reasonably expect seed of not just Pristine's but of all pasture and forage legumes to be selling as fast as it could be produced. However, that is not happening, and the barriers to that adoption are the same barriers that must be addressed and overcome before the extremely worthy and eminently achievable policy directions outlined above can be successfully implemented; to not just mitigate the direct impact of shortage of rain, but to overcome and reverse the economically and biologically unsustainable impacts of crop-centric rotations.

[*] It might be somewhat superfluous to add here, but it is nevertheless notable that pasture improvement with legumes will significantly increase efficiency of production and cut methane emissions per unit of production. This is because legumes are higher quality feed and pass through the rumen more rapidly; reducing both the time the feed is exposed to methanogenic activity and the amount of feed needed to grow the animal. Supplying system nitrogen in an organic form via legumes should also reduce nitrous oxide emissions by comparison to supplying that N via fertiliser. This technology can thus enable Australian agriculture to make significant cuts to greenhouse gas emissions right now.

<u>Conclusion.</u> The manifest decline in productivity, profitability and sustainability of current grain crop centric systems, and consequent increasing vulnerability to climate change and drought, can be reversed very effectively with both current and new technologies using rotations with improved legume pastures.

5. Barriers to system change; general.

It is our observation that since farming became grain crop centric in the 1980's, over time all of the industries based on broad acre farming have become figuratively and literally addicted to cropping. At the farm level, the addiction is psychological, in that farmers are inherently change averse, are attracted by the occasional large gross income cheque from their crops, (even though if it actually comes, about 80-90% of this ends up paying costs) and they like to spend time in the comforting cocoon of their tractor cabins. Off farm, the addiction is far more "physical". Growing a grain crop is expensive and complex, requiring large inputs of cash to purchase advice, fertilisers, chemicals, new technology, machinery and even finance. Hence for every farmer growing a crop, there are three to five people off farm who directly rely on him doing so to generate their income. If he does not sow a crop, they are without that income; hence their financial need to keep the farmer growing crops.

Like drug addiction, addiction to grain cropping has lead to a progressive decline in health; in this case of soils and the economic viability of the farm business enterprise. Nevertheless, because this has happened over a protracted period rather than instantly, in a classic combination of the boiling frog syndrome and our capacity to be able to protect ourselves from reality via self-imposed tunnel vision, it has been possible for the manifestly negative impacts of this crop addiction to be ignored.

The other industry wide barriers to these vital attitude and system modernisations centre on knowledge gaps and ignorance of the underlying changes and trends that have developed over the years as a result of the shift to grain crop-centric farming systems and the loss of legumes and legume N inputs. So far as we are aware, the above analysis of these trends and impacts is the only one of its type. There may be others, but if there are, they have certainly not been given the publicity that is warranted in view of the fundamental importance of what they indicate for broad acre agriculture. Further, even though gross margin calculations are almost universal tools used to determine what individual farmers should grow, we are also unaware of any serious attempt to account for or cost net N movements into and out of crop systems at any level. As the losses of N from the system are akin to major rundowns of vital production feedstock, and in light of the fact that cost of replacement via N fertiliser now comprises some 20-30% of the gross income, we believe that is now an inexcusable omission.

A full analysis of crop trends and inclusion of N accounting in provision of agronomic advice is without doubt both in the public interest and a vital need for broad acre agricultural enterprises to become more self-reliant as is sought by this enquiry. Unfortunately, while there were a series of long term rotational trials being run in the 1980's that if continued would have provided an invaluable source of trend information, both government and Rural Research and Development Corporation (RRDC) support for these was withdrawn and trials terminated. Subsequent events show that was foolhardy, and as expert analysis predicted negative impacts of the grain crop centric rotations that were becoming popular at that time, it is not just hindsight that leads to this conclusion. This is an area that needs immediate re-vitalisation in terms of new trials, in detailed re-analysis of old trial data, of gross trends revealed by ABS and ABARE data, dissemination of analysis results right across industry, addressing of critical industry knowledge gaps, and immediate implementation of cost accounting for soil N changes right down to an individual paddock level.

"Crop addiction" and the "knowledge gap" alone will severely impede transition away from unsustainable grain crop-centric farming systems. This vital reform is unlikely to be successful without finding ways of addressing these overarching factors, as well as the individual barriers present within all levels of industry.

6. Private sector barriers; specific comments.

Advisers/agronomists. As noted, growing grain crops is complex and requires extensive technical and expert advice as supplied by professional advisers and agronomists. By comparison, growing pastures and forages is much simpler, so that with a few exceptions advisers and agronomists focus almost exclusively in advising their clients not just on how to grow grain crops, but to grow them irrespective. Even where the crop fails, the agronomist still gets paid, and if the farm enterprise is failing, then banks generally require even greater agronomist involvement as a condition of further credit. Our experience is that while not all agronomists are blind to the value and importance of legume pastures and forages, many are, and some very influential ones are openly boastful about getting their farmers to get rid of all their stock and focus just on grain cropping! ***Agronomist vested interest is profoundly crippling for any reforms that do not directly involve grain cropping. Overcoming this barrier***

will be fundamental to instituting changes to boost farm enterprise resilience and self-reliance.

Banks and financial institutions are also significant vested interests, in that they supply the credit that enables farmers to purchase all the very significant inputs necessary to produce a grain crop. By comparison, forage crops, pastures and even pasture improvement does not generally require the farmer to seek large amounts of credit. To date, crop credit has been a great deal so far as the finance institution is concerned, as the asset backing of the farm ensures that their money is at little risk, even where the crop does fail. In reality, increased rain drought risk coupled with farmers locked into unsustainable cropping, the rundown in soil N reserves (the N drought) and consequent degradation of the real value of farm land resource, is now placing the value of the asset backing and the loans against that asset at considerable risk. However, both banks and financial institutions are shielded from that reality by the rest of industry. For example, they rely on the same advisers who advised the farmer to grow grain crops in the first place to then advise further when things get tight.

As a small footnote to this, N drought, like a permanent rain drought, will eventually render land uneconomic for any cropping. That will mean that such crop land; typically valued at say $2,000 to $3,000/ha will need to be re-valued on its animal carrying capacity; or around $500/ha. However, farm loans will have been made against the inflated value, so that what was thought to be a 50% equity for example, will turn out to be a very significant negative equity. When the financier finally calls that debt and the farm is put on the market and sold at real value, the farmer will be left with many hundreds of thousands of dollars debt, and no choice but to declare bankruptcy. The farm itself will be left to finally die, and the financial institution to carry large losses; which across the industry amount to many billions of dollars.

Like the sub-prime crisis, this house of cards based on over-valued land assets could undergo widespread and catastrophic collapse in response to a simple trigger; such as in this case, a drought. While current foreclosures are an early warning sign, we do not believe that broad acre agriculture is at that point currently. However, with every passing year during which the N drought is allowed to intensify and the consequent real value of farmland continues to be eroded, that collapse will get ever closer.

Returning to other major private sector vested interests that make their income principally to almost entirely from farmers growing grain crops include chemical, fertiliser, new technology, fuel and machinery suppliers. While these are less directly influential on what the farmer does do, they do have indirect influence, in that for example, if a farmer wants to know what chemical might be needed for anything other than a grain crop, the supplier is unlikely to know, and probably doesn't have it in stock in any case.

7. Public sector and related barriers; specific comments.

While it is expected that the public sector will provide a source of information or industry development support (eg through R&D) that is free from or above external pressures, and will serve the public (and industry) interest, the reality in the case of broad acre agriculture is somewhat different. ***Like the rest of the industry, the public***

sector is also addicted to grain cropping and for basically similar reasons. Their income is grain crop dependant, because that is where the focus of the rest of industry is centred.

The other major related factor is the ***Rural Research and Development Corporation (RRDC) system, which as the major driver of industry R&D, has failed to address sustainability as an issue (or to even monitor it) or the wider needs for change.***

On the R&D side of public sector activities, funding for individual R&D projects is almost entirely reliant on appeal of that project to agricultural industries, as assessed through the various (RRDC) R&D support application processes. In the case of broad acre agriculture, the Grains Research and Development Corporation (GRDC) is by far the largest funder of R&D, with other RRDCs taking a minor role. GRDC itself invests more than $100 million annually in this R&D, and leverages up a considerably greater amount of public funding in the process. Nevertheless, as it is on their watch that the manifest breakdown in the sustainability of broad acre farming systems has developed, but to this day remains un-noted, this funding and assessment model warrants analysis and review.

At the moment, there is no doubt that this has become a major barrier to change. For example, despite the fundamental importance of nitrogen and therefore legume pastures to the profitability and sustainability of farming within the wheat-sheep zone, virtually no money is being allocated to these areas of R&D. In the most recent funding rounds, only about 0.5% of the GRDC budget was allocated to pasture R&D (all relating to existing grants) and nitrogen itself scarcely rated a mention beyond a single small project relating to N efficiency. This is also reflected in all aspects of technology transfer. ***Issues relating to nitrogen, legume pastures, rotations and sustainability are low priority and often barely rate a mention by GRDC, and even strenuous efforts over many years and through multiple channels on the part of Pristine has had no discernible impact on that.***

While this is in part due to the funding priority directions initiated within the GRDC in particular, it is also to a significant degree reflective of the appropriateness of the R&D approach of the public sector to rotation, systems and pasture research.

As noted, public sector funding for rotation and systems research was severely cut 20 years ago. Expertise was lost (eg through retirement) and hasn't been replaced, leaving a serious gap in the capacity of the public sector to initiate good systems R&D proposals.

Funding for pasture R&D has also been reduced over the period, but a reasonable professional base that is capable of initiating new R&D proposals remains extant. However, the major directions for this R&D are basically the same as those of more than 20 years ago; that is the focus has been and still is largely on the development of new pasture legume varieties to suit old systems. Since the early 1990's, an absolute plethora of varieties (about 50) have been produced, most of which are very narrowly focussed in their adaptive range and of very little commercial value. They have been a barrier in themselves, in that they have served to confuse the market place to the extent that varieties are frequently sown outside of their adaptive range, and

ultimately fail. Those farmers trying to do the right thing by their rotation system are thus put off from doing so.

Further, this thrust to simply churn out new varieties with little thought of commercial reality had the perverse effect of downgrading efforts to improve on existing systems and to develop mainstream pasture legumes to suit evolving new systems. That led to formation of Pristine Forage Technologies; from former public sector staff working in these mainstream areas who saw these real market opportunities and industry needs and sought to fulfil them. That was successful; Pristine varieties and technologies suited to new systems as outlined previously are now available for more than 80% of the wheat-sheep zone area. However, having initially ignored this industry need, significant elements of the public sector Pasture R&D effort have now been refocussed to attempt to simply reproduce what Pristine has already achieved.

Apart from being an imprudent and ridiculous waste of precious public resources and further adding to confusion, this also diverts attention and effort away from addressing the manifest areas of market failure within this field. For example, much knowledge of the key drivers of pasture production has been lost over time, and there is major need to bridge that gap via pasture and systems agronomy R,D&E. At the moment, the public sector is not initiating and GRDC and RRDCs generally are not getting pasture and systems R,D&E applications that they can reasonably support; eg that are focussed on addressing these and other areas of market failure.

The whole area of (mainly public sector) R,D&E is vital to achievement of the changes that are necessary to fulfil the new policy expectations and directions being investigated through this enquiry. However, it is scandalously dysfunctional, and leads to, explains and reinforces the general industry ignorance barrier mentioned above. Major overhaul is needed to turn it from being a barrier to modernisation and into an effective agent for innovation and advancement.

<u>Conclusion</u>. The need to change current unsustainable and damaging grain crop centric practices will be hampered by a whole of industry dependence and focus that has grown up around grain cropping, such that adoption of more sustainable practices is already severely handicapped by a combination of;

- ***an industry-wide reluctance to change,***
- ***off-farm industry vested interests that are very heavily reliant on farmers sowing grain crops, but are not subject to the checks and balances of on-farm crop system or enterprise decline or failure,***
- ***a domination of entrenched and reactionary interest groups (mainly public sector) in R,D&E direction setting and project selection processes,***
- ***a critical, nation-wide lack of support for farming systems R,D&E,***
- ***a consequent serious deficiency of industry knowledge and understanding of longer term (negative) impacts of current farming systems,***
- ***wasteful use of public sector pasture improvement R,D&E resources to develop new pasture varieties with little or no commercial value,***
- ***a serious shortage of pasture agronomy and direct pasture improvement R,D&E.***

8. Overcoming barriers; the knowledge barrier.

We believe that overcoming this barrier is fundamental to successful implementation of change so that farmers can begin to adopt robust, sustainable farming systems to survive rain droughts and climate change, as well as reverse the N drought.

In the first instance, this will require the wide dissemination of existing knowledge, albeit initially in a generic rather than a specific sense. I***ndustry will need to be made aware that nitrogen mining, farming costs, grain crop yield and stock carrying capacity trends, and consequent sustainability predictions for current farming systems strongly suggest the need for major system change, irrespective of drought.*** That knowledge needs to be packaged and disseminated in a coordinated fashion through existing channels and should be specifically publicly funded and coordinated for the public good within the public sector; perhaps via a specific farming sustainability R,D&E unit with considerable extension expertise within CSIRO.

Secondly, existing knowledge and technologies need to be demonstrated and validated and new knowledge across an array of relevant disciplines in agronomy and farming systems developed for specific regions. This R,D&E should be launched as early as possible, so that farmers will be equipped both to begin changes to their systems and not be stalled in their progressive improvement waiting for the next steps. It should be carried out through existing systems of funding and R,D&E provision, via long term commitment of state departments and RRDCs.

However, given the dysfunctional nature of current R,D&E in this field and its failure to identify the critical trends referred to previously, strong concerns exist for the capacity of existing structures, operational systems and people in their present forms to be able to carry this through effectively and efficiently.

With respect to the RRDC s in general and GRDC in particular, we feel that this chance should be taken to look at and suggest a significant revamp of both their R,D&E direction setting and overall governance and accountability mechanisms.

- GRDC is in an essentially incestuous relationship with the public sector and particular industry vested interests (eg industry agronomists and advisers). Virtually all funding is directed to support public sector R&D, most of which is reactive rather than proactive, and is stuck within particular paradigms (eg in its focus on grain cropping). Professional agronomists and advisers who likewise focus on grain cropping, largely control technology transfer activities supported by GRDC. Consequently, there is a lack of innovative thinking or approach, new ideas and technologies get little or no discussion, consideration or airplay, and the pace of genuine change is glacial. Invigoration through far greater independent, professional science and business input into the organization and a change of culture to engender a willingness to critically evaluate current paradigms and to embrace new ideas and directions is needed at all levels.
- Appropriate systems of corporate governance and accountability as well as transparency in decision-making processes must be both introduced and be seen to be formally operating; again at all levels of GRDC. There is the appearance and a consequent strong suspicion that various individual conflicts

of interest are not declared and not properly handled from a corporate governance responsibility perspective. For example, many projects and programs that receive funding directly involve individual panel or even board members, and technology transfer activities supported often reflect the focus of the agronomists that are funded to organise them. What are the protocols for declarations of potential conflicts of interest and for appropriate exclusion of the member/adviser from consequent decision-making processes?

If the commission should feel that it is outside of their brief to make specific recommendations along these lines, some note of the expressed concerns and systemic failures and shortcomings as mentioned is warranted. It may also be useful to suggest that some form of further independent enquiry be undertaken on this front.

With respect to R,D&E, there is a vital need for new investment to support development of new human and physical resources to address key needs, and for current resources to be re-directed to support this policy initiative as appropriate. In the former case of new investment, as noted above, there is a strong need for new long term rotation and systems R,D&E, and the building of appropriate expertise to support that. As farming systems R,D&E was basically dismantled across Australia in the 1980's and 1990's, much of this will need to start virtually from scratch, although some existing resources and expertise in soil science in particular can form a core around which new groups can be built. In the case of the latter, existing public sector expertise in pasture R&D should be reassigned from pasture and forage variety development (how many more new varieties that are not being used are needed??) and towards (D&E) validation, demonstration and quantification of (generic) benefits of pasture legumes in rotations, and of basic agronomic principles of pasture/forage production in major regions. This would achieve two goals; firstly ending the unnecessary waste of (public) resources that are currently being used to create new varieties with little or no commercial application, or for attempted duplication of and destructive competition with the private sector, and secondly instead, addressing long-standing R,D&E needs that are manifest areas of market failure and which will deliver huge public good outcomes.

Both of these generalised initiatives should be supported through a mix of (existing/new) public and RRDC funding.

9. Overcoming other (industry and farm based) barriers.

Overcoming the knowledge barrier by dissemination of currently available information on yield decline, system sustainability, nitrogen and other nutrient accounting and costing, etc, is vital to overcoming off-farm barriers to change. In particular, there should be a breaking down of grain crop centric thinking in favour of broader, systems based approaches among professional agronomists and others providing advice to farmers, as if the impacts of factors mentioned above (N, yield and sustainability) are known, then advice will need to account for them accordingly. If it were not so accounted, then individual farmers and/or their financiers could hold the adviser professionally liable when systems do fail and businesses suffer consequent damage. Thus for example, an adviser will be professionally responsible for ensuring that soil N bank changes as a result of particular systems and crops are costed and included in calculations of gross margins, etc. Because that knowledge

has not been widely available, professional advisers could avoid this accountability or any claims of legal liability, even though their advice has often been severely defective in addressing longer-term systems needs, and a significant factor in the serious deteriorations in farming sustainability parameters noted. Thus dissemination of critical systems information widely throughout the entire industry is a vital step forward, and as noted above, there is a significant role for government here in funding this dissemination.

The other major barrier is in farmer and industry resistance to change in a generic sense. This will restrict adoption of critical new, more sustainable technologies and systems, particularly in respect of pasture improvement and the pivotal role of legumes for restoring system productivity, sustainability and profitability. While dissemination of the knowledge that current systems are unsustainable and likely to collapse at some time in the future will lead to some reappraisal of those systems, there will still be the tendency for a very large majority of most farmers to sit on the sidelines and wait, rather than take the initiative to look at alternatives. Without strong signals and incentives for change to these better systems therefore, it is likely that many enterprises will continue to weaken as profits fall and farm soils progressively lose nutrients, health and their value as an asset.

Farmers and industry are likely to need some forms of gentle persuasion and incentive not just to initiate change, but to also drive it in the right direction, at least in the early years while the industry as a whole is evolving and adapting to the circumstances in which they now find themselves.

Most of the initiation for change needs to come from the farmer, as in general, farmer demand for specific advice is the driver for industry to develop the information base, and the skills and capacities to provide that service and advice. *

We have identified two major specific means whereby government can signal both intention to drive change and the direction of that change (in this case for using rotations incorporating improved legume pastures); and to provide incentive for farmer adoption of these better systems and practices. These are:

1. Provide direct (partial) rebates on (fee) costs for professional advice provided to broad acre farmers seeking assistance with respect to pasture improvement and related issues.
2. Provide direct (partial) rebates on costs of pasture legume seed and other purchases made by broad acre farmers for pasture improvement purposes.

Both these rebates can be structured to provide incentive for such activities that is not open ended and subject to rort, by imposing both limits to time over which the rebates are available and to the amount of the rebate claimable annually for individual farm enterprises over that time. In both cases, we suggest a five-six year timeframe for these rebates beginning in 2009, with an actual claimable rebate starting at 50% of documented cost incurred for growing seasons 2009 and 2010, and subject to an appraisal of how effective these measures are, scaling down by 10% annually from 2011 to 2015. The amounts claimable per farm enterprise could be limited to a particular maximum amount (say starting at $5 000 p.a., scaled down as per above

and/or linked to farm/enterprise size as determined by average gross income generated).

While these rebates may lead to some market distortions (for example by driving up seed prices) that is likely to be minimal, and if anything beneficial rather than deleterious to the industry as a whole. At present, local sales of all pasture legume seed are very slow indeed, with vital seed sitting in sheds effectively dying, so that the seed rebate incentive is needed just to start moving this seed into the field. The other specific barrier in that respect is getting sufficient numbers of growers and area to produce enough seed of these pasture legumes to satisfy projected industry needs. To put it in context, at current levels of production and local sales, it would take many, many decades to complete the transition to the improved systems as outlined; by which time, millions of hectares of productive land would have been irretrievably degraded and long since lost to production. Hence, some farmer/market incentive is needed to both shift seed, and to put some upward pressure on price of that seed in order to attract the new seed growers that are needed to expand production.

The role of these incentives is to kick-start the change and adjustment process. Once these systems are in the field where farmers can see them operating successfully, and knowledge of these new systems begins to flow from R&D, then increasing numbers of farmers will have the confidence to adopt these technologies. ***The absolutely critical step is to get over that initial barrier of inertia to change, and to do so before farm enterprises are brought to the point of collapse,*** as the greater the health of the enterprise to begin with, the easier it is for it to deal with the unknowns that inevitably arise during any change process.

We believe therefore that such a rebate for seed purchase cost in particular will provide multiple positive drivers for enterprise evolution to self reliance and for adoption of sustainable production systems by firstly sending an unequivocal signal that these changes are viewed as essential for broad acre agriculture, and secondly to provide the necessary impetus to all sections of the production chain, from seed producer to farmer, to facilitate transition to the point where the adjustment process becomes self-driving.

We also note that the cost involved in these proposals is unlikely to be substantial in size (we forecast the total cost to the taxpayer will be less than $5 million p.a. over the six years) and in light of the manifest benefits, is likely to result in strong positive increases in tax revenue alone that will vastly outweigh the outlays made. Conversely, a continuation of current grain crop centric systems will continue to see a progressive rundown of yields, of production capacity and area, and of soil health, these collectively cutting billions from gross farm income and from GDP. As this is at the moment virtually completely reversible via the means outlined, a continuation of the current slide would be a needless and tragic mistake.

[*] The exception is where the farmer is in severe financial difficulty, such that the bank or supplier of farm finance needs to take some control over what the farmer is doing in order to protect their loan. However, in that case, the bank has a very strong vested interest in determining what the best directions for that enterprise are, and driving the farmer accordingly. That will therefore be driven and underwritten by the knowledge dissemination processes described above.

<u>Conclusion</u>. If left to itself, industry will almost certainly continue to take the short term views that are responsible for the widespread degradation and productivity decline that is now evident. It therefore falls to government to take the initiative, to provide clear signals to industry as a whole and to drive system adjustment forward in the face of expected strong inertia and a significant undercurrent of opposition. Overcoming that inertia and opposition is pivotal to successful adjustment and will require a multi-pronged approach that is both resolute and flexible. Some of the suggested necessary changes include;

- ***re-establishment of long term farming systems R,D&E, supported by government and RRDCs***
- ***redirection of current public sector R,D&E resources away from pasture and forage variety development towards agronomic R,D&E to promote adoption of more robust farming systems based on pasture legume rotations.***
- ***a review of governance, direction setting processes and accountability within RRDCs in general and GRDC in particular to improve performance and relevance of R,D&E to longer term industry needs,***
- ***education of industry as a whole to be responsible for taking a longer term approach to farming and accountable for placing emphasis on sustainability,***
- ***short term support such as (partial) rebates for costs of professional advice and for direct costs incurred in initiating farming system improvement (eg for pasture legume seed purchase) to kick-start adoption of more sustainable and stable farming systems.***

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