21 Steps to PA in Australia

Plan for Incorporating Precision Agriculture into Australian Farm Management in 2007

Guidance through the stages in Table 1 may be achieved by following a decision tree which requires a positive or negative answer to decide on an individual incorporation path. A Plan for Incorporating Precision Agriculture into Australian Farm Management in 2007 has been devised to assist Australian farmers. It begins with the decision whether to move into some form of vehicle navigation aid. While the use of vehicle navigation aids is generally recommended as the initial step, the use of the later stages of the plan do not necessarily require such systems (e.g. small farm size and turnover may preclude such initial purchases but not the possibility of improving management of variability). Please refer to the document Incorporating Precision Agriculture into Australian Farm Management for a full discussion of the procedure.

Table 1. Relating PA Progress Stages to the 21 Steps in the Incorporation Plan

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<th>Progress Stages</th>
<th>Incorporation Steps</th>
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<td>1. Optimise ‘uniform’ crop management</td>
<td>Steps 1 to 11</td>
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<td>2. Determine the magnitude, extent and responsiveness of spatial and temporal variability</td>
<td>Steps 12 to 17</td>
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<td>3. Optimise the production input/output ratio for quantity and quality (to maximize gross margin and minimize environmental footprint)</td>
<td>Steps 18 &amp; 19</td>
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<td>4. Output quality control and product marketing</td>
<td>Step 20</td>
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<td>5. Modernising resource-base and operation information</td>
<td>Step 21</td>
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PLAN FOR INCORPORATING PRECISION AGRICULTURE INTO AUSTRALIAN FARM MANAGEMENT IN 2007

STEP 1. **DECISION ON ACQUIRING A VEHICLE NAVIGATION AID** (guidance/steer assist/autosteer)

Obviously a reliable autosteer system with a locally provided correction solution that operates in the +/- 2cm accuracy range or below, will provide the best operational results in all situations. However, the cost of these units and the benefits that an individual farmer wishes to access means that the decision may not be purely based on best-performance. The short survey below will help farmers clarify what options they may have prior to contacting retail merchants.

(a) Is the amount of overlap you employ in chemical application operations greater than 5% in terms of ha/farm? YES NO

(b) Does your local environment and soil types make parts/all of the farm susceptible to vehicle-induced compaction that may be limiting productivity? YES NO

(c) Do you see a need for vehicle-based operations on your farm to be more timely, efficiently undertaken at night if necessary, undertaken by different operators with a more uniform result? YES NO

(d) Do you envisage incorporating accurate inter-row operations? YES NO

(e) Would you accept a 2-5 year financial payback to navigation equipment investment? YES NO

**Response Assessment**

*All questions recieve a NO response:*
The use of vehicle navigation aids is not applicable for your operation at this time.

*All questions recieve a YES response:*
An advanced form of vehicle navigation aid (e.g. autosteer) should be considered for your operation.

**YES to question (a) only:**
low cost, sub-metre steering guidance system may be suitable for your operation.

**YES to questions (a) and (b and/or c):**
A decimetre steering assist system may be suitable for your operation.

**YES to questions (d) and (e) and optionally (a) and/or (b) and/or (c):**
Consider an autosteer optioned system for your operation.

Further, more detailed information on acquiring and using vehicle navigation aids can be found in the GRDC PA manual (www.grdc.com.au) and the Tramline Farming Systems: technical manual (Dep’t Ag WA Bulletin 4607).
STEP 2.

CONTEMPLATING MOVING TOWARD SITE-SPECIFIC CROP MANAGEMENT

To take PA further on-farm and utilise the navigation aid equipment more fully, the impact of variations in landscape/soil, previous management actions and climate on the variability in crop production can be investigated. The Site-Specific Crop Management (SSCM) concept exists today to facilitate this investigation and help in improving management decisions if required.

Importantly, the amount of variability in resources and crop yield found on individual farms and fields is unique to each site. This is crucial as it means that there is no single management prescription that can be defined for SSCM. But, it also provides the greatest impetus for exploring the use of SSCM, because the best information for optimally managing each farm/field will undoubtedly be derived from within its own boundaries.

So, with the understanding that local variability will be the driving factor and therefore that local agronomic understanding and advice should be incorporated at the key exploratory and decision stages, a generic plan for considering the incorporation of SSCM into farm management in Australia is presented.

This plan is comprehensive in that it begins with the realisation that crop yield may not be uniform across a field/farm and provides a well researched set of actions to cover most scenarios that may occur, in most Australian regions, with the knowledge available in 2007.

An important point in this decision process is the ability to quantify yield variability because it drives the initial motivation and it is also critical in assessing the results of any changes in management. To provide a plan that is potentially useful to all farmers, objective quantification using crop yield monitors or calibrated biomass imagery is recommended.

Some farmers may wish to use their local knowledge of resource and yield variability to bypass some of the stages described here or to target specific local variability issues that are regarded as important and easily identifiable. As long as people are comfortable with the assessment of the size of the initial yield variability, its cause and the ability to assess the impact of management changes, then less technological aids may be required.

For the most comprehensive benefits, however, it is recommended that physically documenting patterns and quantities of variation is undertaken for present assessment and decision-making, auditing past actions and for future analysis. If this can be done at a resolution that is satisfactory to those involved without the use of some or all of the sensing systems identified as useful in this plan, then proceed.

It is certainly feasible to use manual switching or multi-pass application to achieve basic variable-rate applications if they are required. Employing variable-rate technology with positioning systems just makes the job less stressful and allows more sophisticated positioning and rate adjustments.
4. Do you believe that portions of the farm yield differently?

5. Are you interested in quantifying and investigating improved management of this variation?
   - Yes
   - No

6. Are you interested in testing your expectation?
   - Yes
   - No

7. SSCM is not for you at present
   - Quantify yield variability on your major crop using yield mapping or biomass imagery. If the whole area cannot be mapped, choose enough paddocks to represent your expectation of the variation.

8. Use local knowledge of past management and seasonal influences (i.e. disease pressure, frosts, harvest problems) to assess the patterns exposed in the maps. Yield differences of 2 to 5 fold are commonly seen. If you don’t see enough natural yield variation, do not proceed. Consider the reasons and either re-assess the same paddocks in coming seasons or choose new paddocks next season. If variability is sufficient, investigate low and high yielding areas of the paddocks/farm (consider weed scouting, soil/crop chemical & physical tests, noting relative position in the landscape).

9. In light of the information gathered, assess basic agronomy across the farm using local and seasonal knowledge.

10. No basic agronomy problems identified.
    - Carry out any general alterations to management that are identified i.e. improve weed management, change average fertiliser rates, modify seedbed manipulation, alter traffic control etc.) then at the end of season...

11. Basic agronomy problems identified.

12. To minimise initial exploratory costs and cover extremes of farm variability, choose the most uniform and most variable paddock and commission a soil ECa survey (EM38h) and an elevation survey (elevation may be obtainable from autosteer). More paddocks may be simultaneously explored based on local situations and decisions.

13. At this stage, depending on your variability in production and the number of seasonal yield assessments undertaken, it may be wise to gather another season’s yield data before moving to the next stage. If you have 2 or more or have a strongly patterned variability that is corroborated by the ECa mapping then press on...
A General Introduction to Precision Agriculture

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14. Combine soil ECa, elevation and yield maps to produce management class maps for each paddock. (see chapters 5 and 8 for procedure).

15. If the production differences remain large enough, investigate each class at 3 random sampling points for causes of observed variation (site-specific soil physical and chemical properties, landscape attributes).

16. No basic amelioration issues identified.  Basic amelioration issues identified.

17. Soil, landscape and climate are combining to provide variability in production potential. Managing inputs for the different potentials identified in the management classes is warranted. Just which inputs will depend on the results obtained from the investigation. Determining rate changes can be done through input response experimentation within each class, testing traditional rates aimed at reassessed yield goals or testing rates calculated on a proportional nutrient removal approach (see chapter 5 for practical detail). Collect the seasons yield information to document the effect of the trials and reassess the management classes......or

18. Once this cycle has been completed with satisfactory agronomic results and understanding, implement the determined changes and expand to other areas of the farm as deemed suitable.

19. Consider inseason real-time monitoring (i.e. Greenseeker, NSensor) and response options either by combining with management classes or stand-alone using local calibrations.

20. Measure quality parameters to ensure yield manipulation is not impacting on quality.

21. Explore marketing and supply chain options (environmental and quality premiums). Use data gathered to improve property values, business funding, planning and risk management.
The Science of Precision Agriculture

So Mr Smith, the theory says that you should need less fertiliser down this end of the field

Brett Whelan & James Taylor
Australian Centre for Precision Agriculture
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www.usyd.edu.au/su/agric/acpa