CONSENSUS-BASED PRAIRIE AGRICULTURE AND AGRI-FOOD SCENARIOS TO 2005

PREPARED FOR

AGRICULTURE & AGRI-FOOD CANADA

PRAIRIE FARM REHABILITATION ADMINISTRATION

AND

RURAL SECRETARIAT

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SUMMARY

GENERAL

After completion of the original Western Canada economic study, Scenario Analysis Model One (SAM1) for the Prairie Agricultural Landscapes Project (PAL), the PFRA requested the study be enhanced by replacing Census Division (CD) data with Soil Landscapes of Canada (SLC) data. Agriculture and Agri-Food Canada provided Serecon with a data set containing about 85,000 elements. Eliminating empty SLC codes, combining production categories and creating a "collection" SLC category for each province cleaned up and reduced the size of the data set. By inputting data at the SLC level, the second model, Scenario Analysis Model Two (SAM2) can be used for microanalysis while still providing output at the macro level.

The assumptions used in SAM1 were based on averages (Canada-wide, provincial, and CDs). These same assumptions were also used in SAM2. In SAM2, it was assumed that the boundaries of the SLCs are congruent with the CD boundaries. These assumptions should create relatively small differences in macro outputs of SAM1 and SAM2. However, at the micro level (SLC) these differences can be relatively significant. Two versions of SAM2 were created, a 'Base' model and a 'Scenario II' model. The microanalysis is new, but the outputs for the macro analysis are based on the original SAM1 outputs.

Changes to production can be inputted at the Western Canada, Land Practice Group (LPG) or SLC level. A new sheet, 'Warnings' was created. It provides a summary of the excess/shortage of cropland and tonnes of feed (by Western Canada, by province and by LPG). If changes to land use are inputted at the macro level then individual SLCs may have to be adjusted to completely balance the model. That is, the hectares of land used by various crops in each SLC have to be adjusted to ensure there is no excess/ shortage of land in each SLC.

The major changes from SAM 1 to SAM2 are related to the calculation of the excess/shortage of crop hectares and tonnes of forage. These elements are now available at the SLC level and summarised by LPG, province and Western Canada. In SAM1, it was assumed that any production not allocated to domestic use or export was an excess/shortage (no consideration was given to changes in inventory). In SAM2, it was assumed that 1996 was in balance, that is there was no excess/shortage in any category. The calculation of excess/shortage of forage was done in tonnes of production only. The conversion of these quantities to hectares was discontinued, since the required hectares vary significantly with both the area (SLC) and the type of land, unimproved pasture, improved pasture dry land, improved pasture irrigated, alfalfa and hay dry land, and alfalfa and hay irrigated.

OVERVIEW

The results of the analysis identified a number of interesting issues to consider when looking at the prospects for growth in prairie agriculture. The SAM1 and SAM2 represent potential production in Western Canada, as identified in the Medium Term Outlook (MTO) and by industry experts, but portrayed on different geographic bases. The complexity of the agricultural industry is such that it is common to see a wide divergence in the estimates of production and/or revenue. However, despite the divergence of opinions, there is a general understanding that industry growth, regardless of its magnitude, will require increased efficiencies in terms of resource usage. SAM2 allows for the analysis of the requirements by SLC and LPG.

The use of the 1996 Census of Agriculture as the base for the analysis, while having a number of drawbacks, does allow for a consistent source of base data in all industry sectors. It must be re-emphasized that SAM2, as with SAM1, was not designed as a macro industry forecasting tool. Instead, this analysis provides a systematic process by which the impacts of industry projections can be brought back to the SLC or LPG level in terms of the ultimate impact on the land base. The model is not limited to using 1996 production and/or productivity patterns, and as better

raw data becomes available, it can be incorporated into SAM2.

Projected exports from prairie agriculture did not vary from SAM1 to SAM2. These remained at $12.6 billion in the base case to a maximum of $19.6 billion in Scenario II. It should be noted that these figures are directly related to current market access, prices, and exchange rates and include the Other Agricultural Production category. However, the key issue of concern is the relative availability of the natural resource base for production purposes. It is possible to evaluate various production projections at the SLC and LPG level using SAM2.

RESULTS

The success in attaining the goals outlined in SAM1 and SAM2 were constrained by the available land base in Western Canada, and by specific levels of productivity as identified by the MTO prepared by Agriculture and Agri-Food Canada and by industry contacts. There was a shortage of 2.8 million hectares of cropland in both SAM1 and SAM2. The shortfall of forages varied from 3.377 million hectares in SAM1 to 3.851 million hectares in SAM2 for Scenario II. It is important to remember that the term "shortage" only refers to the SAM1 model output, and that these figures actually represent an opportunity for increased efficiencies or productivity increases that are required, above and beyond those predicted by industry contacts, in order to meet the projections outlined.

There are a large number of changes that could occur in the agri-food industry in order to reduce and/or eliminate the projected shortage of land: increase and/or adjust input use intensity whether it be capital, fertilizers, chemicals, water use, or rotational considerations. However, the ultimate impact of any of these changes would be an increased production efficiency of the land base. Rather than doing an analysis of a significant number of potential changes that could be made, SAM1 and SAM2 were used to estimate the level of efficiency increase that would be required in order to meet the industry projections.

Grains and Oilseeds

As a total, the prairie region had a deficit of over 2.8 million hectares under Scenario II in both SAM1 and SAM2. This deficit would require a significant productivity increase in order to generate the production forecast in the MTO or by industry experts for the prairies.

The following table outlines the results of the analysis, by Model, for cereals and oilseeds, and by province.

Table 1
Productivity Changes (%) Required in Order to Balance Resource Availability (Scenario II)

	SAM1		SAM2	
	Grains	Oilseeds	Grains	Oilseeds
BC (PR)	N/A	N/A	N/A	N/A
AB	10	47	11	46
SK	22	135	20	125
MN	19	56	18	51
W CDN	17	83	17	77

In SAM1, the excess/shortage of production was based on the difference between these two values in 1996 and 2005. In SAM2, it was assumed there was no excess/shortage in 1996. In order to compare the productivity changes between SAM1 and SAM2, the excess/shortage of production as calculated in SAM1 for 1996 was combined with excess/shortage calculated by SAM2 for 2005. The calculations were completed on the combined data and are outlined in Table 1.

The macro output of SAM2-Scenario II, shows very little difference in the production changes required to balance resource availability for the grain crops when compared to SAM1 output.

The results suggest that under SAM1, Alberta would have to increase grain productivity by 10 and 11% under SAM2 in order to balance land resource availability given the production demands. Saskatchewan would have to increase productivity by 22 or 20%, and Manitoba would have to increase productivity by 19 or 18% in order to balance their resource supply and product demand, depending on SAM1 or SAM2. In total, the Prairie Provinces would have to increase their grain productivity by an average of 17% as estimated by either Model.
The required relative productivity for oilseeds between the Models shows a greater difference. For

example, in Saskatchewan, oilseed productivity has to increase by 135% in SAM1 and 125% in SAM2. For Western Canada, the required increase is 83% in SAM1 as compared to only 77% in SAM2. These differences result from applying broad gauge averages to relatively small areas and the non-congruence of SLC and CD boundaries.

Forages

Forage production is generated from three separate sources: tame hay, alfalfa and fodder, and native pasture. While the productivity in terms of tonnes/ hectare of tame hay and alfalfa/fodder produced is similar, the productivity of native pasture is generally significantly lower. This fact is further complicated since the productivity of forages on irrigated tame pasture/alfalfa/fodder is different yet again.

The exports of forage and forage products is assumed to come from the tame hay/alfalfa/fodder production, as is the forage used by feeder animals. However, the forage requirement for cows can also be served by native pasture. The number of cows and feeders, and the use of tame hay versus native pasture, varies by SLC and LPG. In many cases, data on the number of cows by SLC and LPG includes livestock that are trucked to native pasture areas in other SLCs or LPGs during the summer months. While it is relatively straight forward to estimate the excess/shortfall of total forage production, it is difficult to estimate the excess/shortage of forage hectares by SLC/LPG and by type of production.

The results of the analysis suggest that there is a projected shortage of forage production in Scenario II, SAM1 and SAM2.

Both Alberta and Saskatchewan are in a deficit position. The issue for Alberta appears to be the large number of cattle. Saskatchewan, despite having a significant land base, has very low productivity in many of its native pastures. This low productivity is not necessarily due to management practices, as there are numerous climatic factors that have to be considered, especially in the brown soil zone.

The total forage surplus/shortage in hectares is less in SAM1 than in SAM2 for Scenario II. The aggregate difference for Western Canada is 474,000 hectares or 2.2% of the available hectares. This does not appear to be a significant difference. In order to show that the use of averages creates potential differences, the shortage calculated using Western Canada averages was compared to the sum of the provincial averages. Summing the provincial averages results in a shortage of 3,851,000 hectares while using the Western Canada average results in shortage of 3,527,775 hectares, a difference of 323,000 hectares created by the comparison of four averages to a single average.

Table 2
Summary Comparison of Available vs Required Hectares (000,000 ha)

			Scenario II	
		Available	**SAM1 Surplus (Shortage)**	**SAM2 Surplus (Shortage)**
Crop Hectares [1]	British Columbia	0.138	+0.028	0
	Alberta	7.6	(.582)	(.606)
	Saskatchewan	13.3	(1.753)	(1.767)
	Manitoba	3.9	(.424)	(.438)
	Total	**25.0**	**(2.730)**	**(2.810)**
Total Forage (aggregated based on average productivity)	British Columbia	0.499	+0.216	(0.049)
	Alberta	10.5	(1.252)	(1.248)
	Saskatchewan	7.4	(2.688)	(2.266)
	Manitoba	2.8	+0.346	(0.286)
	Total	**21.13**	**(3.377)**	(3.851)
Total Surplus (Shortage)			**(6.107)**	**(6.651)**

[1] Alfalfa and fodder hectares are included under the forage category for this analysis.

In summary, the intent of the project was to examine the changes in agriculture and pressures on the land base under different agricultural growth scenarios.

The growth projections utilized for Scenario II, SAM1 and SAM2 were identified based on a consensus of industry experts' opinions. The SAM1 and SAM2 were then used as a tool to identify and quantify the relative pressures on the land base at the CD level and the SLC/LPG level respectively for the projection. This information suggests that projected industry expansion will require increased efforts addressing productivity and management practice improvements in prairie agriculture and agri-food production.

DOCUMENTATION OF SAM2

INSTRUCTIONS AND DESCRIPTION

The following provides information on the process used and assumptions made in the creation of SAM2.

- Obtained initial data set of 1637x51=83487 cells
- Follow-up to obtain data on SLCs numbered "9999"
- Obtained additional data from PFRA and integrated it into data set
- Integrated additional data of three BC SLC codes
- Deleted all "Water" entries (1533 rows left)
- Deleted all SLCs that were empty (1251 rows left)
- Created new columns as follows:
  - SLC, Prov, CD, LPG
  - Cows = bfcows
  - Feeders = heifer+steers+calfu1
  - Sows = sows
  - Poultry = tchick
  - Dairy = mlkcow
  - Grain ha = whtspg+whtdur+whtwin+oats+ barley+totrye+totcrn+tritcl+othgrn
  - Oilseed ha = flsxsd+canola+mustsd+othoil
  - Sp Crops ha = totdrbn+lentil+fpeas+canary+ ofield+totveg
  - Hort. ha = potats+sugarb
  - Crop L ha = crplnd
  - SummF ha = summrf
  - Imp P ha = impast
  - Unimp P ha = unimpst
  - Alf&hay ha = alfalfa+ottame+forage
  - Manbure t = manuprd
  - Ir ha = irrig [note: (Ir%=(1r ha)/ (Crplnd+Impast)]
  - Corrections required:
  - CropL ha = (total crop – alfalfa&hay) added alfalfa&hay back in again
  - Imppst ha = (tame past&alfalf&hay) subtracted alfalfa&hay
  - Poultry = #layers*2 (not *7 due to 7 cycles per year)
- Balanced SAM2 and original data by Province

Incorporated four new artificial SLC codes, one for each Province (NN8888=SLC; NN88=CD; 888=LPG) representing about 19 in MB, 178 in SK, 85 in AB and 2 in BC)
Data to balance SLC census data to original data was entered into these cells.
Corrections applied:
- If sows = -1 and tototpigs >0 then sows = tototpigs/10; else = 0
- Allocated animals to SLC = -1 remainder in NN8888
- Hectares if positive then split amongst SLC; negative in NN8888
- Othland if -1 moved unknown into it unless negative
- Manure estimate in original seems low, about half, so new will be about double the old

Data set cleaned – removed negative numbers from NN8888 SLC
- MB – Feeders distributed over all cells (+77)
- MB – Alfalfa&Hay distributed over all cells (-58)
- SK – Oilseed distributed to all (0.934)
- AB – Alfalfa&Hay distributed
- BC – Summed last four artificial SLC into one

General eliminated negative number in data except for "Othland"
Verified the "Cropland" and "Total farm land" at the provincial level
Integrated old model into new data set to create "SAM2" model
Expanded the data fields for the animal sections and verified the 1996 numbers
Expanded crops and forages and generally verified 1996 data
Created new interface to verify 1996 financials
Created and inputted the growth tables
Verified 2005 animals, crops, and financials
Incorporated LPG summary into spreadsheet
Created a "Warnings" sheet that highlights possible problem area in the number of crop hectares and the tonnes of forage produced (for Western Canada, by province and by

LPG). Similar highlighting is provided by SLC in the detailed "2005Data" sheet.

Developed Scenario II and generally verified results

- **WC%INP** – Enter desired % growth rates (NOT the annual rate) for the 10-year period from 1996 to 2005 on sheet "WC%Inp". The growth-input table is hierarchical, that is, if data entered for WC it is copied to the LPG, however once data has been entered for an LPG then any subsequent change in WC is ignored. Similarly, if it is desired to change the growth rate of a specific SLC, this can be done on the "96-05Growth%" sheet. But once the data is changed for a SLC it will no longer respond to subsequent changes in WC or by LPG.

  The number of animals and their feed conversion efficiency can be altered. In addition for pigs, the number of piglets per sow in "S-P-repro" and for dairy cows the number of litres of milk per dairy cow per year in "Litre/cow" can be increased.

  The number of hectares dedicated to various crops, forage, and irrigation can be increased as well as the productivity per dry land and irrigated hectare. This can be done on a Western Canada, provincial, LPG or SLC basis.

  The detailed calculations used to derive the forage and crop numbers used in Table 2, SAM2, Scenario II are available in the attached spreadsheet entitled "March Analysis".

- **Warnings** – Provides a quick reference to show that the number of hectares required or the quantity of forage (tonnes) exceeds what is available. (0.01% to 5% is yellow; >5% is red). Similar warnings are provided by SLC on sheets "1996Data" and "2005Data".

- **Inputs-Gen; Assumptions; Assumptions-Sum** – Same as original model.

- **1996Data; 2005Data** – Sub-totalled data table (4=SLC; 3=Prov.LPG; 2=Prov; 1=WC). An overall LPG table is provided at bottom of the spreadsheet.

- **96LPG; 96-05G%LPG; 05LPG** – Data tables sorted by LPG for further use in graphs.

- **Sum96Prov & Sum05Prov** – A data table by province and Western Canada (for the financial calculations).

- **96-05Growth%** - A data table showing the percent growth over the 10 year period.

- **Prov.Summary; Summary & Financial; Capital & Labour** – Same as original model.

- **SAM2 Scenario II** – Same as SAM2 Base (except industry expected growth assumptions were inputted and used in the calculations).

  Input data used are included as a separate sheet "Scenario II Input". Some of the changes have been made in the "96-05Growth%" table and will not be affected by changes made to the "WC%INP" table. Make changes to this with care to ensure that any change is actually included in the calculations.

  Note: The number of sows does not change with a change in the number of piglets per sow, but the revenue does change.

RESPONSE TO PFRA QUESTIONS ON SAM2

1. *Sow calculation in SAM2 is different than the calculation in the original model. How does it differ and why?*

   In SAM1, the number of sows in 2005 was calculated as = (# of sows in 1996)*(1+% growth in # of sows)*(1+% growth in the number of piglets per sow). All output calculations were based on the effective "# of Sows". That is, any change in the number of piglets per sow was reflected as a change in the number of sows.

   In SAM2, the number of piglets per sow did not change the number of sows, allowing for a more accurate reflection of the number of sows held by producers. The feed and manure data was adjusted to reflect the change in piglets per sow.

   Please note: only the number of sows "exported" in 2005 is adjusted to reflect the increase in piglets per sow (this is required to keep the financial calculations consistent).

2. *The SAM2 does not appear to use the same definition of "available" and "required" cropland and forage land. Why is the approach different, and how does this affect the*

interpretation of the final results in terms of bringing future demands to an equivalent unit – hectares of land?

In SAM1 it was assumed that the total 1996 production = exports + domestic consumption + excess (shortage). No consideration was given to increases/decreases in inventories. This was the basis for the excess (shortage) of hectares in 1996 and 2005.

In SAM2, a better way of approaching the excess (shortage) was used. Since data was available for each SLC, the excess was calculated based on the proposed changes to the number of hectares of each type of crop in each SLC and the available number of hectares in the SLC. (See columns "BP" and "CG" of sheets "96LPG" and "05LPG" and summaries on "Warnings" sheet). Since various crops grow better/worse in various soils, it makes more sense to review and change crop allocation by each SLC than to use a provincial average. The information in SAM2 appears to more accurately reflect the prairie situation.

See the attached spreadsheet "March Analysis" for a detailed description and reconciliation of the surplus (shortage) of forage and crop hectares.

3. *The definitions of the clusters (grains, oilseeds, special crops, etc.) are different between the two models. How do they differ and why? A complete justification of this change is required because the original clusters and the related assumptions were fully documented in the August 1999 report.*

In SAM1 the clusters were:

Grain ha = spring wheat, durum wheat, winter wheat, oats, barley, rye, corn, triticale and other grains
Oilseed ha = canola, soybeans, flax
Special crops = mustard seed, sunflower, safflower, dry field peas, lentils, dry white beans, fababeans, dry coloured beans, canary seed
Horticultural crops = potatoes and sugar beets
Alfalfa and Hay = alfalfa, other tame hay and forage

In SAM2 the clusters used were:

Grain ha = spring wheat, durum wheat, winter wheat, oats, barley, rye, corn, triticale and other grains
Oilseed ha = canola, flax, mustard, other oil crops
Special crops = total dry beans, lentils, field peas, canary seed, other field crops, and total vegetables
Alfalfa and Hay = alfalfa, other tame hay and forage

The variance is a result of the MTO clusters and the data received from Agriculture and Agri-Food Canada by SLC. The only variance, which will be insignificant is mustard moving from Special Crops (SAM1) to Oilseeds (SAM2), and the inclusion of vegetable seeds under Special Crops in SAM2.

Alfalfa was included in pasture not cropland in both SAM1 and SAM2.

The difference of 440,000 hectares of cropland between SAM1 and SAM2 is the result of a change in the approach used. In SAM1, it was assumed that in 1996 any production not required to meet Export and Domestic consumption could be considered as excess capacity in terms of tonnes produced and hectares required for this level of production. This implied there was no change in the inventory level during 1996. It should be noted that the Excess of Crop hectares in SAM1 was only calculated on a total crop hectares basis not for each of the four individual type of cropland, therefore all four types of cropland are affected. The available crop hectares in SAM1 and SAM2 are the same, the difference is in the definition of the required crop hectares results in SAM1 showing a lower amount for "Required Crop hectares" and a higher amount for "Excess (short) hectares" than the amounts shown in SAM2. In SAM2 it was assumed there was no excess production. This results in SAM2 having the "Required Crop hectares" higher by 440,000 hectares than SAM1. This is balanced by SAM2 having the "Excess (short) Crop hectares lower by 440,000 hectares than SAM1.

The above explanation is the major contributor to the difference of 80,000 hectares of "Oilseeds"

between SAM2 and SAM1. The rest of the difference between the two Models is due to the use of a more inclusive definition of Oilseeds in SAM2. The difference of 18,000 hectares of "Special Crops" is because of the same explanation as for "Oilseeds".

The difference of 1,800 hectares between SAM1 and SAM2 in "Horticulture" is based only on the different definitions used between the two scenarios.

4. *The manure calculation in SAM2, for all livestock sectors, produces almost double the amount of manure. How does the calculation differ, and on what basis is the change justified.*

In SAM1 we estimated the amount of manure produced by each type of animal. These assumptions are detailed in the "Assumptions" sheet in column "B", rows 190 to 205. The estimates appeared reasonable since each cow consumed slightly less in tonnes of feed than it created in tonnes of manure. Changing the values used in the "Assumptions" in SAM1 will change the amount of manure produced.

In SAM2, data was supplied by Agriculture and Agri-Food Canada and was used to determine manure production. This increased the amount of manure by about two fold from the estimates in SAM1, but are considered to be more accurate.

In the development of SAM2 more accurate data was available with regard to manure production. Data reflecting the total amount of manure produced in SLC and in each province was available from Agriculture and Agri-Food Canada but there was no data with regard to the amount of manure produced by each type of animal. In order to more accurately reflect manure production, our original assumptions had to be modified. There were three obvious ways of modifying our assumptions:

- Adjusting manure production for each SLC;
- Adjusting the amount of manure produced by each type of animal;
- Adjusting the total manure produced in each province;

The alternative of adjusting the amount of manure produced in each province was chosen. Specifically the adjustment factors were:

- MB 1,578
- SK 2,106
- AB 2,229
- BC 2,410

5. *Correction factors are used in SAM2 in the Feeders & Irrigation Sheet which calculates the % productivity for both forage and annual crops. This is a major component of the production calculation. Please explain in detail and provide an example of how the correction factors were calculated and included in the documentation.*

In SAM1, overall production in Western Canada was 44,276,009,103 kgs produced on 76,491,251 acres or 0.579 kgs per acre (1,430 kgs per ha). This value was chosen as the base or 100%. Overall provincial production was related to this base. (Alberta at 687 kgs per acre had a relative production of 188%). The yield per acre for each CD was then stated as a percent of the Western Canada yield. (CD1 in Alberta had a yield of 512 kgs per acre or 88%). Using this data the total production for each province was calculated. This resulted in more production than the actual for each province. (Alberta was over by 36%, thus CD1 in Alberta was reduced to (88%)*(1/1.36) = 65%). The other alternatives, which were NOT chosen:

Decrease the production assumptions for each crop category by some factor until the overall production met the provincial totals (see "Assumptions" Sheet cells 'B112', 'B131', 'B153', 'B171').

Decrease the irrigation productivity to meet the overall provincial levels.

A similar process was used to determine the tame hay and unimproved pasture production. It was assumed that each cow requires 10 ha of natural pasture. This was defined as 100% productivity. (In Alberta CD1, 1 cow requires 28.9 ha or

10/28.9 = 35%). In order to match the Western Canada totals, 100% productivity was increased to 123%. (Alberta CD1 becomes 10/28.9*1.23 or 42.5%). (The other alternative would have been to revise the "Assumptions" Sheet cells 'B217' to 'B220' until the overall totals matched.)

These factors were transferred from SAM1 and used in SAM2.

6. *The meaning of "production increase" vs "production area" should be clarified for SAM2. It is unclear if, in the original consensus building approach, there was agreement that area of seeded cropland would increase and thus production would increase, or that production would increase, therefore requiring an increase in seeded area. It appears that the model assumes a production area increase, and in some cases a productivity increase, and calculates the production from the increased area of land. It does not calculate, for the annual crop sectors, the land required to meet a given production level, only the affects of the scenario increase. This issue needs to be clarified – in detail, and how the model undertakes to incorporate the original consensus.*

   Both SAM1 and SAM2 allow for the increase in number of hectares of land allocated to the production of a particular crop and for the increase in the productivity per hectare for a particular crop.

   In SAM1, sheet "Input-Prov" cells 'C10' to 'G13' provide inputs for the increase in ha allocated to specific crops; cells 'C23' to 'G26' allow for increases in the yield per ha.

   In SAM2, using Grain as an example, columns 'T' and 'V' allow for increases in production per ha while column 'V' increases the land allocated to growing grain.

   In both SAM1 and SAM2 the increase in crop hectares for each sector is the result of applying a growth factor to current land use or increasing the productivity of the land used to produce the crop. It was not done by calculating the amount of land required to produce a certain quantity of product. The production target for the crop sectors is not identified in the same way as they were in the animal sector. Production levels are calculated from an estimate of the seeded area and productivity advances.

   Since the total amount of cropland is relatively fixed, some increase may be possible by changing the use of the land (e.g. pasture converted to cropland or less summerfallow) but if significant increases in the number of hectares seeded with a particular crop are required then there will have to be a corresponding decrease in hectares of some other type of crops.

   In our opinion, the net effect of the Industry statements about productivity and seeded areas can be used as an estimate of the growth target for each crop sector.

7. *Forage productivity (cows per hectare) was provided to Serecon by PFRA on a Census Division basis, including a weighted average calculation of the amount of each soil zone in a CD. How was this information attributed back to SLCs within SAM2?*

   The number of hectares of unimproved pasture required per cow was inputted for each CD. The base or 100% productivity was chosen as 10 ha/cow. In order to match the Western Canada total, productivity had to be increased by 23%. Each SLC was associated with a CD and the data for that CD was then inputted into each SLC. See SAM2 sheet '1996Data' columns BU', 'BX' and 'CB'.

8. *What was the methodology used to allocate suppressed data and distribute it to the SLCs and/or the undefined cell called 888?*

   About 15,000 cells out of 85,000 had suppressed data. For each grouping the associated cells were summed (for example: Grain ha = whtspg + whtdur + whtwin + oats + barley + totrye + totcrn + tritcl + othgrn). Any existing (-1) were neglected since they would not materially affect the results. All water and all empty SLCs were deleted. The remaining cells were given a cursory overview to determine if a logical allocation of

the 'remaining values' was obvious. If not, the (-1) values were replaced by 0 and the remainders placed into the 888. Specifically:

If sows = -1 and tototpigs >0 then sows = tototpigs/10; else = 0
Allocated animals to SLC = -1 remainder in NN8888
Hectares if positive then split among SLC; negative in NN8888
Othland if -1 moved unknown into it unless negative
Data set cleaned – removed negative numbers from NN8888 SLC
MB – Feeders distributed over all cells (+77)
MB – Alfalfa & Hay distributed over all cells (-58)
SK – Oilseed distributed to all (0.934)
AB – Alfalfa & Hay distributed
BC – Summed last four artificial SLC into one
Irrig – allocated to all -1

9. *The percentage (%) used to allocate irrigated land is different between the two models. Why?*

In SAM1, the amount of irrigated land per CD was used. The percentage of irrigated land for each CD was calculated by dividing the number of irrigated hectares in each CD by the sum of crop hectares plus Alfalfa and Hay hectares; in each CD. The percentage of irrigation for each province was then adjusted by a factor to ensure that the total number of irrigated hectares in each province was equal to the summation of the irrigated hectares in each CD. Summerfallow was not included.

In SAM2, the irrigated land per SLC was available and used. In SAM2 the irrigation percentage for each SLC was calculated as a percent of the total irrigated hectares in each SLC divided by the cropland plus improved pasture in each SLC. Data regarding summerfallow was not available.
In our opinion the methodology used in SAM2 is more reliable since it is at a more detailed level. It should be noted that the total number of irrigated hectares is the same in both SAM1 and SAM2. For example, the total number of irrigated hectares in Alberta is 516,000 hectares in both models.

10. *Does SAM2 balance to provincial level data like the original model did? If it doesn't, why not?*

SAM2 does not balance exactly to provincial level data. The balance was chosen to be at the Western Canada level, but no effort was made to force the data to be exactly the same. The provincial totals ranged from 1 to 5% from SAM1 to SAM2.

11. *In Serecon's opinion, what are the significant differences of the results between SAM2 and the original model?*

SAM2 provides greater accuracy (and probably greater reliability) since the SLC are based on soil conditions, not political boundaries and because of the finer detail (more SLCs than CDs). Also, as more thought goes into the process, the results become more realistic and able to withstand closer scrutiny.