UTILIZATION OF ASPEN FOR ANIMAL FODDER

A Discussion Paper

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INTRODUCTION

There currently exists a food production crisis at the global level. In the view of the United Nations experts this situation has only recently developed, although it had been predicted.

Protein is a highly valued food. To obtain protein, approximately 50 percent of the annual world grain crop is fed to animals. North American grain stocks fluctuate on an annual basis between surplus and deficiency. That is considered by food specialists to be a relatively recent and short term phenomenon. In the longer term, North American grains will be in continuous short supply.

There is a high probability the expanding shortage will result in a redirection of a large proportion of that grain from direct animal to direct human consumption. The animal industry will move towards alternate feeds. Wood fiber, and in particular aspen fiber, must be considered as one of the likely alternatives or substitutes. Aspen is an unexploited, renewable resource. It is highly digestible to ruminants following relatively simple condition.

In this discussion paper I will attempt to 1) emphasize the urgency of the situation by providing some specifics in regard to the food

crisis, 2) provide some background as to ruminant nutritional requirements and attributes of aspen which suggest it is particularly well suited to serve as animal fodder and, 3) I will summarize in chart form essential components to be considered in a research and development program directive towards that objective.

THE FOOD CRISIS

There appears to be considerable support for the following statements paraphrased from recent literature. It is widely recognized, of course, that the crisis in food supply is associated with other factors, principally population growth.

- The less developed countries (LDC's) constitute approximately 80 percent of the present world population of approximately 4 billion. Thirty percent is currently undernourished by United Nations standards.

- Despite an annual increase in global food production the per capita consumption in LDC's has decreased during the past decade. Indications are that trend will accelerate.

- Global population is increasing at a rate between 2.5 and 3.5 percent/annum in LDC's and will double within 30 years. Most optimistic predictions for food production increase are 2 percent/annum.

- No significant amounts of arable land remain uncultivated and most marginal land is under cultivation. Approximately one million acres of arable land are lost annually due to alkalinity, erosion, urban development and transportation.

- No single nation, United States included, can act as a global granary. American grain surpluses will not adequately cover global food short-falls. In good years U. S. grain surpluses constitute 75 percent of the world export tonnage. This constitutes only 6 percent of the global grain production. This tonnage is less than the needs of the three year increment in world population (i.e., approximately 80 million per annum).

- United Nations experts considered 600 million tons of grain in storage as being the safe tonnage to stave off severe famines in localized regions of the world. Since 1972 that tonnage has dropped consistently and is currently less than 100 million tons. The likelihood of a reversal in trend is considered slight.

- World fisheries obtained their maximum catches in late 1960's. The trend is for diminished catches.

- The food crisis is not related solely to population growth. Other factors aggravate the growing food shortage which in turn interacts with those factors. The relations are modeled in the report by the Club of Rome (see attached).

- Recent information relating to climatic change at the global level is particularly pertinent to the food shortage, and disturbing.

- Many climatologists are now convinced the world climate is altering to a pattern considerably less favorable for agriculture and food production. The impact is already being felt around the world; particularly in Africa and the sub-continent of India.

- A $1^{o}C$ drop in mean annual temperature is predicted by some climatologists and it may reach that level, at least, within 40 years.

- Others have calculated the impact of that temperature reduction on global food production. In Europe a $1^{o}C$ drop would result in 20 percent fewer people being fed from domestic sources; in China there would be a drop of 43 percent in available food.

- Between the years 1930 to 1960 the world population doubled, the industrial revolution became world wide, the people of the less developed countries accepted the goals of the materialistic western society and insist on reaching those goals. Most special strains of high yield crops were developed with climatic tolerances adopted to the most favorable recent climate.

- It has been calculated that should the predicted $1^{o}C$ drop in mean annual temperature occur in Canada, it will result in a 50 percent reduction of grain production. Canada will alter from a major grain export nation to being barely self sufficient.

RUMINANT REQUIREMENTS AND ATTRIBUTES OF ASPEN

Ruminants require a great amount of roughage in their diets obtained principally in the form of grasses. Protein, vitamins and minerals are added to upgrade the forage where those nutrients are not present naturally in sufficient amounts.

The table below summarizes, in general terms, Total Digestible Nutrient or digestibility percentages required for ruminant growth. The medium rates of gain, i.e., 2 lb/day, are apparently favored by the livestock industry.

Percent Total Digestible Nutrient (Digestibility)	Animal Growth
40	Maintain level (no growth)
50	Low rates of gain (1 lb/day)
60	Medium rates of gain (2 lb/day)
70+	High rates of gain (3 lb/day)

Ruminants cannot digest lignin, and woody plants contain high amounts. Aspen has the lowest amount of lignin, approximately 18 percent; lowest of all trees in North America. The literature suggests digestibility of aspen sawdust or chips is near 33 percent. A relatively simple steaming process, possibly with pressure, will upgrade that material to 66 percent digestibility levels, with some evidence it can be increased into the 80 percent range.

The steaming and pressure process disrupts the lignin bonding. This in turn provides sites on the cellulose strands for enzymes to commence hydrolizing the cellulose strands into digestible "bits". The enzymes are secreted by the microflora within the rumen.

Greater than 60 percent of the breeding beef cattle in Canada are located in the three prairie provinces, wherein also is located the greater proportion of the nation's aspen. There is a very large farm animal population located within the southern fringes of the boreal forest and the adjacent aspen parklands.

ASPEN RESOURCES

Currently near 25 million acres of Crown land in the prairie provinces are occupied by aspen as the principal plant species. The estimate of existing volume is near 42 billion cubic feet. Utilization varies between provinces from 12 to less than 1 percent. Aspen is a renewable carbohydrate resource, for all intents and purposes, unexploited.

Available biomass figures suggest reasonable comparability with intensively cultivated traditional forage crops. Somewhat better-than-average sites in Manitoba, representative of prairie conditions, can be expected to yield (on dry weight basis) near one ton of fiber per acre per year, between ages of 10 years to 40 years. Brome grasses and alfalfa, traditional forage crops in the parklands of Saskatchewan, can be expected to yield dried tonnages of between 1.5 and 2 tons annually per acre per year.

Recent cost/feasibility studies in Saskatchewan suggest, even in today's terms and with a current surplus of hay, straw and grain, fodder from aspen is competitive; i.e., $45-50/ton vs. $50-60/ton for alfalfa.

Aspen is a hardy fast growing, tree. It regenerates vegetatively from suckers. This results in stands developing into clonal groups, e.g., numbers of trees from same parental stock. This characteristic lends itself to development of genetically superior stock, a useful attribute.

While aspen occurs in great abundance, only a very small percent is currently utilized for wood fiber.

Aspen regenerates, in most cases, with great vigour. Cleared land must be continually managed to prevent rapid reinvasion.

Digestibility trials which have been done to date have not considered the variability in nutritional quality of aspen. Trials have used the most readily available material, generally sawdust or other mill wastes. It is believed, however, young aspen is considerably higher in nutritional value. This would suggest aspen could be managed for fodder on a short rotation basis, possibly 5-10 years. This short rotation would be well suited to natural growth characteristics of the species. During this short rotation period aspen would be amenable to harvest by modified agricultural swathers or other types of moving machinery. Mill waste, of course, must also be considered as a source of feed stock.

Large amounts of money are expended annually by all levels of governments in western Canada to establish and maintain community pastures in the wooded zones. Costs of clearing above are in the neighborhood of $50-60 per acre. Add to that costs of piling and burning, discing and plowing, working down and seeding. Final costs average near $100/acre. In addition there is an annual maintenance cost brought about by persistent reinvasion by aspen suckers.

CONCLUSION

The livestock industry is an important segment of the Canadian food production community. There are compelling reasons to believe the livestock industry will be required to seek other sources of animal

fodder, within a decade. This will be brought about by food shortages at the global level. Aspen has many attributes which suggest it could be one of the alternate new forage sources which will complement regular forage supply.

Early pioneering research into this subject by the Department of Agriculture, the Forest Product Laboratories, and several government sponsored university programs have provided a base on which a stronger co-ordinated research and development program can be initiated.

The nature of the program makes it mandatory it be government sponsored. The need must be viewed in a longer term perspective and governments must anticipate needs and make preparations. The federal government should take the lead role in designing a program which includes important input from provincial governments, universities, and private enterprise.

An overall strategy should be designed and implemented. That strategy should recognize there are at least four principal components to the research and development program: design and engineering of aspen treatment machinery; management of aspen for feed stock; animal feeding and nutrition prescriptions; acceptability and utilization of aspen as animal fodder. Within each component economic realities must be considered. No component can effectively work isolated from others. Optimization needs to be approached in consideration of developments within each individual component. The program should be under close scrutiny of a steering committee consisting of representatives from the appropriate agencies.

A summary follows:

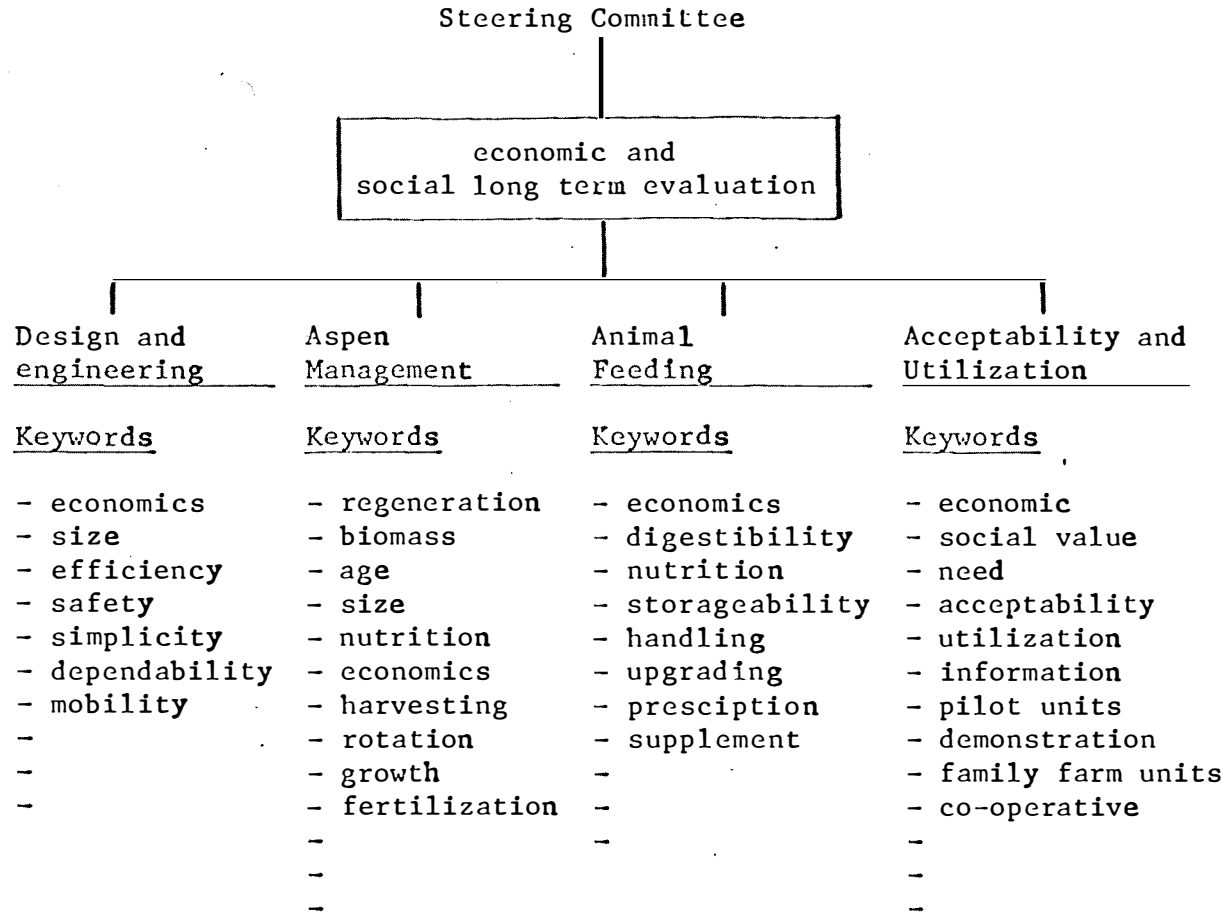
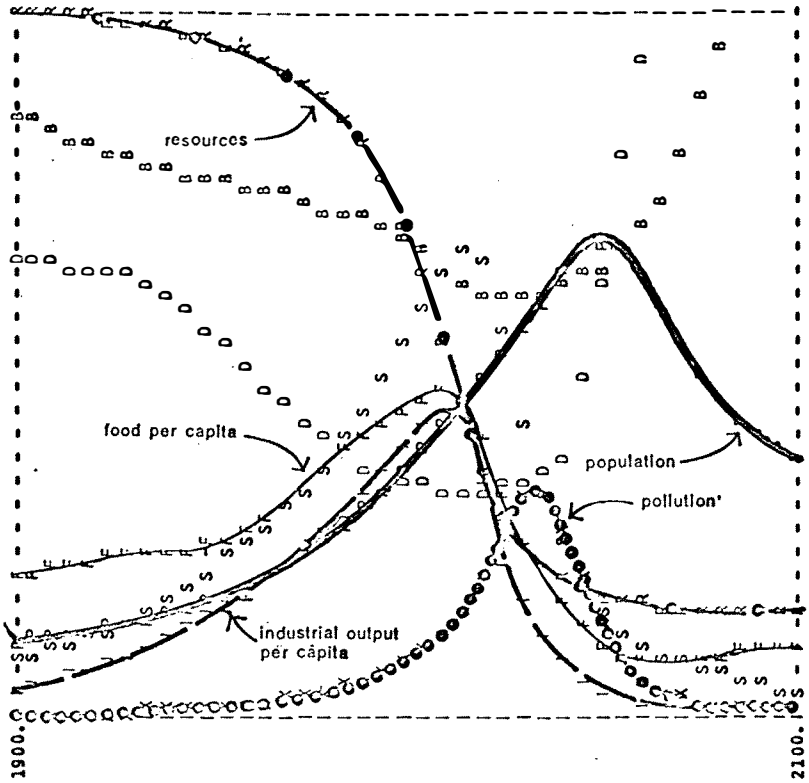


Figure 35 WORLD MODEL STANDARD RUN



The "standard" world model run assumes no major change in the physical, economic, or social relationships that have historically governed the development of the world system. All variables plotted here follow historical values from 1900 to 1970. Food, industrial output, and population grow exponentially until the rapidly diminishing resource base forces a slowdown in industrial growth. Because of natural delays in the system, both population and pollution continue to increase for some time after the peak of industrialization. Population growth is finally halted by a rise in the death rate due to decreased food and medical services.

THE LIMITS TO GROWTH

A Report for THE CLUB OF ROME'S Project on the Predicament of Mankind