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AGRICULTURAL DEVELOPMENT PLANNING FOR AN AMERICAN INDIAN RESERVATION: THE CASE OF THE SISSETON-WAHPETON SIOUX TRIBE

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AGRICULTURAL DEVELOPMENT PLANNING FOR AN AMERICAN INDIAN RESERVATION: THE CASE OF THE SISSETON-WAHPETON SIOUX TRIBE*

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I. Introduction

Few American Indian Tribes have successfully developed the agricultural resources on their reservations. Management problems, fractionated heirship lands, cultural disincentives, lack of physical as well as human capital, and other factors have combined to constrain agricultural production on Indian controlled lands. In many instances, the quality of land has also been poor, but seldom has the production potential demonstrated by neighboring non-Indian landowners been achieved.

In recent years there has been increasing interest among Indian Tribes in accelerating agricultural development. Several Tribes have established Tribally owned farms and ranches. They have emphasized Tribal as opposed to individual Indian ownership and management to minimize the above problems and to provide an economic base for the Tribe in case the federal government withdraws it financial support of Indian Tribes. Tribes see agricultural development as one component of a larger development program to provide income and jobs for those who wish to remain on the reservation.

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The Sisseton-Wahpeton Sioux Tribe in northeastern South Dakota established a Tribal agricultural enterprise in 1975. It received financial assistance from the Economic Development Administration and technical assistance from South Dakota State University. Recognizing the need for additional agricultural planning, its tribal leaders requested assistance from the Federal Reserve Bank of Minneapolis. The Bank relayed this request to a number of institutions[1/] who then coordinated their efforts to support an agricultural economist from the University of Minnesota to assist the Tribe. For the past two years he has worked with the tribal leadership and planning staff in evaluating agricultural investment and organizational alternatives as well as helping with plan implementation.

This paper describes and evaluates the agricultural planning approach used on the Sisseton reservation. It begins with a brief description of the reservation setting and tribal goals. The methodology is then described, the resulting plans summarized, and updating and training procedures delineated. It concludes with an evaluation of the approach and its potential for application to other tribes.

II. The Setting

The majority of the Sisseton-Wahpeton Sioux Tribe (SWST) reside on the Sisseton (Lake Traverse) Reservation which encompasses parts of

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[1/] University of Minnesota, Winrock International Livestock Research and Training Center, Northwest Area Foundation, and South Dakota State University.

five counties in northeastern South Dakota and two in southeastern North Dakota. Agriculture is the primary industry in the area although the farms tend to be small and are mostly owned by non-Indians. Approximately 3,600 members of the SWST live on the reservation representing 14 percent of the total reservation population. Both the Indian and non-Indian migration rates have been high. Per capita income is about $1000 for Indians living on the reservation which can be traced in part to an unemployment rate of approximately 53 percent. The major employer of Indians in the area is the Tribe itself through the various government programs for which it has contracted. Agriculture employs less than 10 percent of the labor force. The educational level of the Indians on the reservation has been rising in recent years, but approximately one-fifth of the Indians 25 years and older have not completed the eighth grade compared to one-eighth of the non-Indian population.

The total land area of the reservation is 918,779 acres. Indian Trust land, or land owned by individual Indians or by the Tribe itself is only about 106,000 acres. It is important to distinguish between the two types of Indian ownership, individual and Tribal. In late 1978, the Tribe owned about 15,000 acres while individual Indians owned the remainder of the Trust land. Usage of the Indian held land is approximately 35 percent cropland, 56 percent pasture, and the rest nonagricultural. These lands are spread out over the reservation in a checkerboard pattern. Most tribal members own small parts of several tracts of land and the vast majority of the tracts have multiple ownership by the heirs of the original allottee. The average number of tracts that each Indian enrolled in the SWST has interest in is eight and the average number of

Indian owners per tract of land is approximately thirteen[2/]. Most of the land is leased to non-Indian farm and ranch operators although Indian operators lease some land.

The Tribe has built up its land base from a meager 800 acres in 1973 with the help of loans from the Farmers Home Administration totaling $4.25 million. It has used the loans primarily to purchase lands from individual Indians which has allowed a consolidation of land tracts. The Sisseton hope to establish Tribal agricultural enterprises on these lands which will: (a) help strengthen the Tribe's economic base in the event that termination of federal recognition occurs, (b) provide "models" for individual tribal members, and (c) generate income which will help them to maintain control over their land base. They want to develop farming or ranching enterprises in all seven political districts on the reservation. These districts have historically been geographic centers for individual clans.

By placing the Tribe itself in control of the agricultural enterprises, they hope to overcome cultural and financial problems, facilitate management, and ensure that as many Tribal members as possible will benefit. The Tribe is also able to absorb risks which individual Indians cannot.

III. Methodology

The Sisseton Reservation is an underdeveloped enclave within a more developed economy. Consequently, there are improved technologies specific

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[2/] U.S.D.I., Bureau of Indian Affairs (1972), The Sisseton Reservation Area, Its Resources and Development Potential, Report No. 204, Billings, Montana, p. 43.

to the area already in existence. What is needed is a mechanism to diffuse this knowledge in a manner consistent with the Tribe's land, capital, and human endowment as well as the cultural, political, and economic environment. The agricultural development process will involve a certain amount of institutional and cultural change as well as technical change. Economic patterns are imbedded in institutional and cultural systems but if these systems do not change over time they die out. The Tribe is aware of this and perhaps this is why they have begun to reorganize their system of property rights through Tribal land consolidation and have sought outside planning assistance.

The first step taken to assist the Tribe in developing an agricultural plan was to inventory the resource base. Data were collected on soils, climate, labor skills, crop yields, input and output prices, water availability, and land ownership. Tribal lands were classified and mapped into capability classes and the lease status of these lands was reviewed. Tribal leaders and the planning director were questioned about their goals with regard to agricultural development and what areas they felt should be emphasized in the study. Three months were spent in the Tribal planning office collecting information, trying to gain an understanding of the situation, and providing some advice with regard to agricultural decisions that had to be made. This contact was important in establishing channels of communication and in gaining credibility. During the remainder of the two-year project approximately 25 visits were made to the reservation to discuss ideas and results and to obtain feedback from the Tribe.

The basic analytical technique used on the project was a multiyear linear programming model (MLP). Crop and livestock budgets were generated

with the aid of the computer budget generator at the University of Minnesota to obtain coefficients for use in the model. Scientists at South Dakota State University, Winrock International Livestock Research and Training Institute, the University of Minnesota, and local extension personnel were the major source of technical information needed to construct the programming model.

The basic objective of the model is to determine a set and level of activities for the farms which maximize ending net worth subject to constraints placed on the enterprises by the availability of labor, land, machinery, credit, etc. Maximization of ending net worth was chosen as the initial objective function because the Tribe expressed a willingness to sacrifice short term consumption to facilitate farm expansion.3/

The activities or variables in the model fall basically into nine classes: (1) crop production, (2) livestock production, (3) renting in of labor, land, and machinery, (4) cattle and feed purchasing, (5) crop and livestock selling, (6) machinery, storage, and building purchasing, (7) borrowing, (8) crop, livestock, and money transfers, and (9) risk transfers.

The constraints and row transfers can be grouped into eight classes: (1) resource constraints, (2) crop transfers, (3) livestock transfers, (4) nutrient transfers, (5) cash flow constraints, (6) credit constraints, (7) net return transfers, and (8) risk constraints.

3/ An alternative objective of maximizing the sum of annual consumption plus ending net worth discounted at 9 percent was also used in the analyses for comparative purposes. The resulting solution was very similar although profits were reduced.

Figure 1 presents an aggregated representation of the model. Most of the activities and rows shown represent numerous activities and rows in the model. The MLP is set up to include five one-year time periods of which two are shown in Figure 1. Crop production activities for 13 crops are included in the model with land divided into four dryland and one irrigated class. Labor requirements, cash requirements, machinery requirements, and set aside requirements for each crop were included. Crop production is transferred in the model to selling, feeding, or storing activities. All land is assumed to be rented from the Tribe by the Tribal farms at the current lease rates established by the Tribe.

Various beef cattle activities designed to reflect the prevailing alternatives in the area are included in the model. They are: (1) a cow-calf operation, (2) summer grazing heifers or steers of two weight classes, (3) winter feeding heifer or steer calves, (4) finishing heifers or steers of two weight classes during the winter, (5) raising replacement heifers for the cow herd, and (6) keeping bulls.[4/] The series of production, purchasing, selling, and transfer activities are represented diagrammatically in Figure 2.

Cattle can be purchased or produced internally. Calves from the cow-calf alternative can be sold at weaning time, overwintered and sold, overwintered and bred as yearlings and summer grazed for heifers, or overwintered and summer grazed for steers. These steers can then be sold or finished over the winter. Calves can also be purchased in the spring

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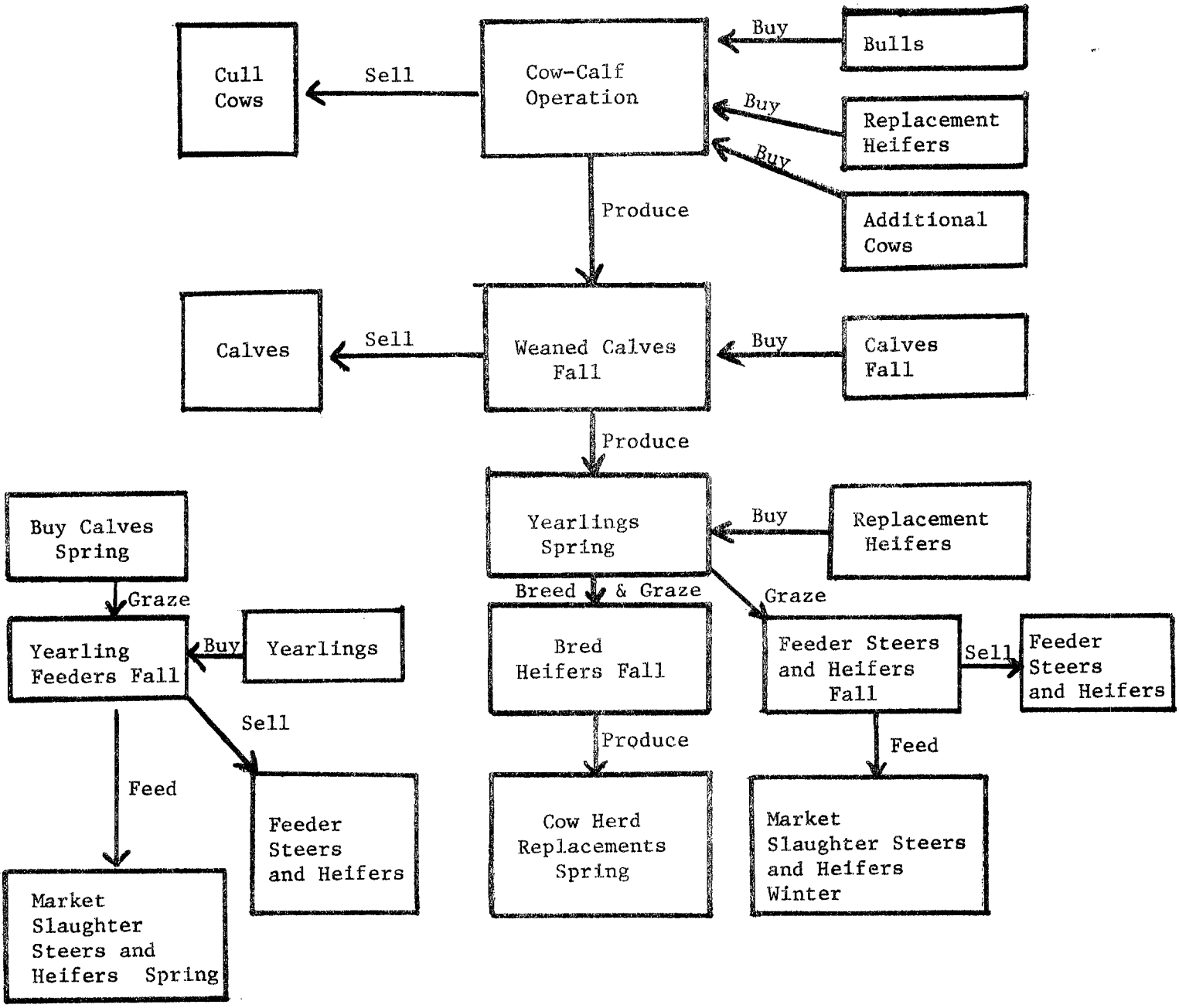
[4/] Fifteen buffalo are also forced into the solution to meet a cultural preference specified by the Tribe.

Figure 1. AGGREGATED REPRESENTATION OF TRIBAL FARM MODEL

Rows \ Columns	Year 1												Year N														
	CP	CS	FP	FT	LP	LS	RR	RP	STF	LTF	IPT	FC	CP	CS	FP	FT	LP	LS	RR	RP	STF	LTF	IPT	FC	RK	DP	EN	RHS
Objective Function																							+					Max
Resource Constraints 1	+				+		-	-																	-	-	+	< +
Crop Transfers 1	-	+	-	+							+																	< 0
Livestock Transfers 1					±	+					+																	< +
Nutrient Transfers 1				-	±																							< 0
Cash 1	+	-	+		+	-	+	+	-																			< ±
Credit 1									+	+																		< +
Borrowing 1								+		-																		< 0
Net Returns 1	-	+	-		-	+	-	-	-	-		-																> 0
Resource Construction N								-					+				+		-	-								< +
Crop Transfers N											-		-	+	-	+							+					< 0
Livestock Transfers N											-						±	+					+					< 0
Nutrient Transfers N																-	+											< 0
Cash N											-		+	-	+		+	-	+	+	-		+					< -
Credit N										+											+	+						< +
Borrowing N																				+		-						< 0
Risk Constraints	±				±								±				±								+			> 0
Net Returns N										-			-	+	-		-	+	-	-	-	-		-				> 0
Increase Equity								+												+			+				-	> 0

Definitions: CP = Crop Production FP = Feed Purchase LP = Livestock Prod. RR = Resource Renting STF = Short Term Fin. IPT = Interperiod Trans.
EN = Equity Trans. CS = Crop Selling FT = Feed Transfer LS = Livestock Selling RP = Resource Purchase LTF = Longer Term Fin.
FC = Fixed Cost RK = Risk Transfers RHS = Right Hand Side DP = Activities to Subtract Depreciation and Initial Cash

FIGURE 2. FLOW DIAGRAM FOR CATTLE ALTERNATIVES



and summer grazed and then sold or kept and finished over the winter. The model also determines the optimal feed mix for the selected livestock activities based on dry matter, digestible protein, and total digestible nutrient requirements and supplies.

Investment alternatives for various types of machinery, buildings, and storage are included in the model. These activities supply hours of machinery use, animal housing capacity, and tons or bushels of storage space. The monetary value of each piece of machinery or other investment is depreciated on a straightline basis and equity is calculated at the end of the five-year plan for each item. This equity is the amount paid off minus depreciation.

There are rows in the model to account for inflows and outflows of cash each month and activities to transfer it from one month to the next. Three borrowing activities are included which reflect the main sources of capital available to the Tribe: (1) long-term borrowing for buildings and irrigation equipment from Farmers Home Administration, (2) intermediate-term borrowing from a conventional bank for machinery and storage, and (3) short-term borrowing from a bank. Each type of borrowing has its own interest rate, downpayment requirements, payback period, and credit limit. A savings alternative is also included for each year to ensure that investments are not made which yield less than the minimum opportunity cost of their capital.

A series of risk constraints and activities are included to deal with price, cost, and yield uncertainty. The technique used is based on the mean absolute total deviation (MOTAD) formulation.[5/] It allows the

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[5/] Hazell, P.B.R., (1971). "A Linear Approach to Quadratic and Semi-Variance Programming for Farm Planning Under Uncertainty," Amer. J. of Agr. Econ., 53: 53-67.

objective function to remain linear rather than become quadratic which is crucial for a model of this size. It is assumed that the decision maker is a risk averter or in other words, expected income would have to be greater for him to prefer high variance of income.

A one-year version of the linear programming model was constructed first and the previous year's Tribal farm operation duplicated. Refinements were made and the model was updated to produce a plan for 1978. A series of plans were generated with varying levels of profit and risk and the Tribe selected the one they preferred. The model was also run with and without irrigated cropping activities such as corn for grain and alfalfa to determine the effect on profits. This information was used to assist the Tribe in presenting an irrigation project proposal to the Economic Development Administration.

The model was then extended to five years and preliminary results were discussed with the Tribal Chairman, Tribal planners, the Tribal farm production manager, scientists at South Dakota State University, Winrock, the University of Minnesota, and local extension personnel. Based on these conversations, adjustments were made in the model and sensitivity analysis was conducted on certain price and yield coefficients. Shadow prices corresponding to the land, labor, machinery and other constraints were also examined. Corresponding to the primal construction of the model described above there is an equivalent dual construction. The values of the dual variables are the marginal values (shadow prices) which provide information on the sensitivity of the optimal value of the objective function to changes in the constraint constants.

A series of ten runs was then made with the linear programming model. These were presented to the Tribal Chairman (the prime decision

maker) and he selected the plan containing the tradeoff between profit and risk which he preferred (a medium risk plan). These plans had been bounded in the first year to fit the total amount of land which the Tribal farm had under lease at that time. The shadow price on Class 1 and Class 2 land indicated it would be profitable to lease more cropland. The decision was made by the Tribal Chairman to include additional land and a new set of plans were generated. Other adjustments were made as suggested by the production manager, the plan was then constrained to fit the fields exactly for 1979, and the model run once more.

IV. Results

The five-year plan developed for the Tribe includes barley, spring wheat, soybeans, sunflowers, and alfalfa as the major dryland crops and corn for grain and alfalfa as the major irrigated crops (see Table 1). Total acreage increases to about 3,000 acres by 1983 from the current 2,000 acres of which 2,000 acres would be crops or improved pasture and 1,000 acres in native pasture. An additional corn planter, a tractor, and a grain dryer are the major investments planned to support these crops.

The major livestock activities are summer grazing of steer calves and finishing of yearlings in a farm feedlot over the winter (see Table 2). Construction of a feedlot enters the plan in the first year and is expanded in the second year. A full-time labor force of three men is needed along with additional labor during peak periods. Capital is a major factor constraining the planned farm expansion. This expansion will require borrowing from outside financial institutions especially for livestock and

TABLE 1

Five Year Cropping Plan

Activity	Unit	1979	1980	1981	1982	1983
A. Crop Production	Acre					
1. Corn for grain	"	80	0	0	0	17
2. Corn silage	"	0	0	0	0	54
3. Soybeans	"	0	167	125	100	144
4. Oats	"	0	0	0	0	0
5. Flax	"	0	0	0	0	0
6. Barley	"	127	197	232	382	254
7. Spring wheat	"	306	132	173	2	266
8. Alfalfa (established)	"	154	154	154	120	0
9. Alfalfa with wheat nurse crop	"	59	71	6	51	0
10. Alfalfa with oats nurse crop	"	0	0	0	0	0
11. Sunflowers	"	107	185	279	285	281
12. Improved pasture	"	170.3	276	360	400	188
13. Native pasture	"	674	763	733	1000	1000
14. Native hay	"	94	100	200	200	200
15. Corn silage irrigated	"	20	15	0	0	0
16. Alfalfa with barley nurse crop,irrig.	"	33	49	0	0	0
17. Alfalfa (established) irrigated	"	0	33	82	82	82
18. Corn for grain, irrig.	"	277	233	248	248	248
B. Set Asides	Acre					
1. Corn	"	37.7	25	25	25	32
2. Wheat	"	73	41	36	11	53
3. Barley	"	32	49	46	76	51
C. Land Rental	Acre					
1. Class 1	"	409	669	859	869	893
2. Class 2	"	588	490	429	434	446
3. Class 3	"	243	249	349	349	200
4. Irrigated	"	330	330	330	330	330
5. Class 4	"	674	763	733	1000	1000

TABLE 2

Livestock Production Activities in Five Year Plan
(numbers)

Livestock Production	1979	1980	1981	1982	1983
1. Cow-calf units	50	60	60	60	60
2. Winter steer calf	21	25	25	0	0
3. Winter heifer calf	45	28	28	53	25
4. Finish steer calf	316	399	399	399	399
5. Finish heifer calf	0	0	0	0	0
6. Summer graze steer calf	245	401	403	403	256
7. Summer graze heifer calf	0	0	104	232	0
8. Summer graze yearling steer	0	0	0	0	0
9. Finish heavy steers	0	0	0	0	0
10. Raise replacement heifers	13	5	13	13	92
11. Bulls	3	3	3	3	7
12. Buffalo	15	15	15	15	15

machinery purchases. Overall net worth increases by $62,000, while cash on hand increases from $60,000 to $200,000. Other activities not included in the model, which have a higher profit potential but also a higher risk, may become feasible if management and labor capabilities are improved.

Sensitivity analysis was used to show how the selection of activities changes as prices, yields, and constraints change. For example, if the price of sunflowers was reduced from $.10 to $.09 per pound they tended to be replaced by corn for grain. Barley, wheat, flax, and to a lesser extent, oats were competitive in the solutions. The cow herd expanded if summer grazing of calves and yearlings were forced out of the solution.

V. Plan Updating and Training

Two questions that will be important in determining the success of the planning effort are (1) how will the plan be updated and (2) how will management and labor skills be improved? The main purpose for including five years in the agricultural plan is to help the Tribal leaders make decisions in the first year which are consistent with their long-run objective and resources. Annual updating of the model will be needed and will be a key to future planning efforts. The updating process will involve the following steps: (1) the planning staff person assigned to monitor the Tribal farm will send to the person updating the linear programming model a list of possible new tracts of land, an inventory of crops and livestock on hand, information on loans outstanding, and other relevant data. (2) Crop, livestock, and input prices will be updated and the crop and livestock budgets regenerated. (3) This information can then be entered into a revision program which has been written and stored on computer

tape to facilitate updating of the LP model. (4) A series of computer runs will be made with the model under varying levels of risk. (5) Basic tables will be written up and the plans discussed with the Tribal decision makers. One of these plans will then be selected or at the Tribe's request the model can be rerun forcing certain activities into or out of the solution. Tables and other information presented should include a projected profit and loss statement, the crop and livestock plans, monthly cash requirements, labor requirements, machinery and building investments, and borrowing requirements. The Tribe has budgeted money for this updating procedure.

The updated plan will be of little value without stable well-trained managers and workers. The current manager is a non-Indian because the Tribe does not feel they have a qualified person to fill that position at the present time. In an effort to develop potential managers, an unsuccessful attempt was made to interest Sisseton High School students in using Bureau of Indian Affairs scholarships to go to an agricultural college for training. These students would have been employed by the Tribal farms when not in school. At the end of their four years in college they would work full-time on the Tribal farms either as managers or as assistant managers. Renewed efforts by the Tribe must be made to interest high school students in training for the management positions.

A one-year training program was run on the reservation for sixteen trainees part of whom run their own small farms and part of whom are potential farm laborers. One formal class was held per week and the trainees spent the rest of the time working on their own farms or on an assigned farm such as the Tribal farm. An agricultural instructor taught classes drawing on the Cooperative Extension Service for assistance.

VI. Conclusions and Evaluation of Methodology

The tribal farms will provide a small economic base which will eventually provide investment funds for other activities. The effects will be mostly indirect via multiplier effects because profits will not be divided up among tribal members and the size of operation projected over the next five years is small. Employment will be provided directly for only 3-4 people. Tribal farms provide examples for individual Indian farmers and if the tribal farms are successful they can help attract capital for expansion in other districts on the reservation as well. Even so farming will never be a major source of employment for Indians on the reservation but can be used as part of the support for an overall development program.

The Tribe should continue to expand their present two Tribal farms into viable units with crops and livestock with which they are somewhat familiar while they gain experience and establish a record of success.[6/] The type and level of activities the Tribe should employ are largely dependent on the type of manager it is able to attract and how well it is able to train its labor force. Better managers can attempt certain types of higher risk, higher potential profit activities because they reduce part of the risk through their own actions.

The type of analysis conducted in the Sisseton study is an attempt to provide Tribal leaders with planning tools capable of considering

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6/ A number of other agricultural alternatives with which tribal members have less experience were also considered during the study such as swine, poultry, sheep, and irrigated vegetables but were not included in the linear programming model. These may well become viable alternatives in the future after the Tribe gains experience and improves its agricultural management and labor skills. They could then be added to the model.

the interrelationships among crop and livestock alternatives over time. The LP model provides plans consistent with the major components of the Tribal resource base. The Sisseton-Wahpeton Sioux Tribe feels the plans generated fit their needs and they are currently following the one generated for 1979.

Two key questions are whether the approach used would be useful for other Tribes and whether the project in fact will have a lasting effect on the Sisseton agricultural situation. A brief look at certain aspects of the project approach provides some insights into the answers to these questions.

The linear programming model contained a good deal of reservation specific information which was needed to provide reliable results. This means that modifications in activities and constraints as well as coefficients would have to be made before transferring it to other situations. The basic structure, however, could be transferred to other settings without much difficulty.

A number of aspects besides the analytical technique were important to any success the Sisseton project has experienced. Frequent communication with the Tribe was of primary importance in all stages. Personal communication was used to transfer ideas, to obtain feedback, and to develop credibility.

Second, the Tribe was committed to the project and participated in terms of time, labor, ideas, and money. A good indication of their commitment was their attempts to solve their own agricultural problems even before they solicited outside assistance.

Third, the plan involved an adaption of the current situation rather than a drastic change in what was already being done. Plans were also

kept flexible. In 1978, for example, they were altered first to compensate for credit difficulties and second to compensate for a slowness in constructing a fence.

A fourth important aspect of the project was the strong technical support from South Dakota State University, local extension personnel, Winrock International Livestock Research and Training Center, and the University of Minnesota. Information and assistance were needed from a number of disciplines and the Tribe needed to be advised where they could obtain various types of technical assistance.

Continuity in planning or maintenance of the planning process for Tribal agricultural enterprises will be important in the future. When a new idea is introduced which requires socio-cultural change such as scientific planning of a modern Tribal farming operation, one cannot determine if the change will endure until it has been integrated into the pattern of behavior of the Tribe. This requires the establishment of an organizational and technical maintenance pattern. The idea for this type of approach to agricultural development began with a strong motivational basis because there was a need felt for it. It has been nurtured by a strong, capable Tribal Chairman and Tribal Planning Director since its inception. If it is to last over time, certain organizational changes should be made to make it less dependent on the support of one or two individuals. It has been recommended that the Tribe incorporate the Tribal farms and select a board of directors composed partly of Tribal members and partly of outside persons who can lend additional technical expertise.

Finally, the Tribe will have to designate and train someone to monitor the plans being implemented by the farm manager. In the longer run the tribal farms will have to show sufficient profits to convince the tribal membership that they are worthwhile endeavors. Hopefully, the tribal farming experiment will succeed and additional development projects devised so the Tribe can realize their goal of providing an economic base to support those who wish to remain on the reservation.