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RANGE DEVELOPMENT AND GRAZING SYSTEM PLAN FOR THE ASSALE-SERBEWEL PROJECT AREA

GUIDELINES & DESIGN

AL00-028

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DECEMBER 11, 1975

APPROVED: _____ DATE: 12-5-75

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CDO/N'Djamena

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X. APPENDIX CONTENT

GRAPHIC SECTION

(Filed in a separate binder for each Grazing Block)

CONTENTS

1. Base map of Grazing Block - (showing vegetative types, water courses, Lake Chad, main roads, main villages, etc. From LCBC November 1974 Edition).

2. Overlay - Existing wells and river water courses in dry season - (other than Lake Chad shoreline)

3. Existing village locations (by larger and smaller size class).

4. Grazing system pasture design (with pasture numbers and beginning stocking guideline).

5. Grazing system treatment sequence (by seasons for years 1 through 12)

6. Range improvements proposed

   (Management marks, revegetation, water development guide for dry season pastures. Final decision for need, location and design for each range improvement is to be confirmed by on-site surveys coordinated with the current requirements of the grazing system plan.)

7. Grazing treatment legend w/beginning guideline stocking and practice summary.

Serbewel Project area based on and directed to the following tasks:

1. A summarization of certain previously prepared surveys of the range and cropland ecosystems in the Assale-Serbewel Project area. These included both agrostological and socio-economic studies prepared through the Lake Chad Basin Commission by Drs. A. Gaston and S.P. Reyna respectively, plus material from miscellaneous other sources.*

2. Brief field checks of the validity and application of the information made available for planning.

3. Preparation of a Range Development and Grazing System Plan. This plan is based on the best information made obtainable in the time frame. It is tailored to meet the constraints of the total environment so far as these can be identified at this time and designed for optimum benefits for the people during both the short and the long term.

4. Preparation of this draft report which includes reasons for the grazing system recommended.

A. Team Composition

This study and report is prepared by a team composed of one Agricultural Engineer and one Range Management Specialist, both assigned through personal services contract.

B. Timeframe and Field Coverage

The work was performed between October 7 and December 13, 1975 during which time field travel in the project area included Fort Foureau, Maltam, Arade, Bada Kouda, Amari Mada, Tilde Goulfey, Kobo Kabir, Telde and Salke, Cameroon and vicinities, and N'Djamena, Ponbelele, Djermay, Tom Marfain, Ayaki, Karal el Greger, Tourba, Al Mekora and Am Guilfel and vicinities, in Chad. Yaounde, Waza, Mora and Marroua, Cameroon were also visited to contact key project personnel. Flood waters prevented travel to some areas in both Cameroon and Chad.

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* See list of references.

C. Project Status and Management Situation

Water development, animal health and tsetse fly control has already been undertaken in the project area.

About 25 wells have been recently completed (19 on the Assale sector and 6 on the Serbewel sector). More than 35,000 calves were treated for internal parasites in 1974 and 1975. The vaccination program has covered about 220,000 head of cattle and the tsetse fly control program is mostly completed and on a maintenance basis. Progress in establishing certain infrastructure and in other items relating to the above, including relating with livestock owner groups and individuals, has also taken place.

No range management plans for carrying out adequate livestock grazing systems on the project area have been designed or implemented. Grazing practices are mostly farm-related and are traditional yearlong continuous selective grazing with no planned livestock population control. Range resource degradation from past and current livestock grazing is obvious.

The Astrological Study completed by Dr. A. Gaston and the Socio-economic Study completed by Lr. S.P. Reyna both completed in 1974, provide a comprehensive inventory on the ecosystem upon which decisions in this report and Range Development and Grazing System Plan are heavily based.

D. Format

The overall proposed Range Development and Grazing System Plan is comprised of four Grazing Blocks in the Serbewel Sector and five Grazing Blocks in the Assale Sector. The location, shape, size and design of the Grazing Blocks is based on information provided by the agrostological and socio-economic studies by LCBC and by sector personnel regarding the existing patterns of grazing, the livestock movements by wet and dry seasons and existing locations of water and forage resources.

The Plan is comprised of a Narrative section and a Graphic section. The Narrative section is addressed to all of the Assale-Serbewel Project area considered as one Grazing Unit and comprised of the proposed 9 Grazing Blocks. A Graphic section is provided in a separate binder for each of the nine Grazing Blocks.

A guideline model for a village farm and grazing system plan is also attached. These Plans will need to be made for each village or groups of villages in the communities in each Grazing Block and closely adjacent vicinities in adjoining Blocks and necessary organization structure developed to accomplish this on the village level in advance of final implementation of Grazing Block Plans.

I(I) Discussion and recommendations:

A. Need for awareness of a downward environmental trend

The northeast corner ot the Assale-Serbeouel project area is now less than 50 Km (30 miles) from the west edge of over 2,000,000 hectares of sand dunes interspersed with relic and still deteriorating rangeland segements which remain. This is the present point of progress and the trade mark of almost completely destroyed "Sahara" rangeland. The most damaging impact to the remaining rangeland environment in this low rainfall zone continues to be made by livestock grazing.

B. Malnutrition continues to be key constraint to production and stability

The project has apparently had good success in livestock health and pest control measures. Livestock herds are now able to increase more rapidly than in recent history. The key limiting constraint for increased or stabilized livestock production still continues to be malnutrition due to the badly damaged and further deteriorating livestock forage habitat on the rangeland environment.

C. Professional level direction in integrated rangeland village Cropland management is a must at this point in time:

This condition can only be adequately challenged and met by improving and stabilizing the quality and quantity of the rangeland resource thru an adequately integrated village and Grazing Block-rangeland/cropland Grazing System.

D. Grazing practices must accomodate the forage plant growth requirements:

Unless a comprehensive irrigation project is considered in this 400-600 mm rainfall zone, rangeland improvement can only come by managing the semi-sedentary village and nomad livestock in a manner that can and will adequately meet the growth requirements of the desirable native forage plants. By creating a favorable situation for desirable plant growth thru the managing of livestock, the forage production potential of this range can be restored and regularily utilized to its current potential. Stabilization of this range resource is long over due and will become more complex, costly and higher risk as the rangeland continues to deteriorate. The time period in . . this can be shortened by also implementing "artificial" revegetation projects together with the adequate Grazing System. However if the present livestock management is not adequate to maintain the desirable native perennial grasses and their potential high production, which it obviously cannot, then of course it would be fruitless to attempt to pit or deep furrow drill and seed these desirable grasses until livestock management is adequate to sustain them. Furthermore the rangeland area

is so immense that livestock management alone must, in a practical sense, regenerate improved forage production on the vast majority of the land, if it is to be accomplished at a reasonable time and cost.

E. The most desirable grass plants can manufacture their food reserves for livestock forage only in their green leaves.

The only opportunity afforded the most desirable forage grasses to recover from previous grazing impact is during the wet (growing) season. That is the only time that these plants can manufacture and store their food. They can only make and store food thru their green leaves which have escaped grazing in the wet (growing) season. Where all of the plant's green leaves are cropped short by livestock for several consecutive years, that plant and usually millions of others around it, grazed likewise, are literally starved to death. After they are thus killed and decomposed, a void is left in the top soil "binder" and forage production, and the silt from the top soil can start to blow and become a part of the dust storm with the "Harmattan". This is one of the common range site deterioration processes chargeable to livestock grazing without adequate management.

F. Some requirement for stability and improvement of the Rangeland-cropland Ecosystem.

If livestock are to continue to graze in significant numbers on the Assale-Serheouel ecosystem, then the plant growth requirements of the Rangeland-cropland Ecosystem must be met by carrying out an adequate Grazing System as a common accomplishment.

G. Range development and Grazing System plan is addressed to this objective.

The plan is designed to reach the objective on the total project area within the earliest reasonable time period. The team believes that period will be 10 years at the earliest.

H. Pilot project characteristics.

This project is a pioneer in fully challenging the imposing range management responsibility in this "Sahel-Sudan" "lower rainfall" zone. The Grazing System is designed to meet the several formidable constraints while providing for increased and stabilized off-take. The thrust of the project must therefore necessarily be one identified as a Pilot project.

I. Utilize traditional organization to fullest extent.

Because of the cultural concepts and practices common to the Project area, the program must be directed to fully utilize the traditional organizations to apply meaningful range and cropland extension.

J. Top quality extension at all levels.

The theme must direct emphasis to identifying, relating with and improving organization and extension at all administrative levels in quality and quantity required to bring about understanding and commitment to applied semi-arid range ecology, in depth.

K. Certain understanding in depth must preceed development.

The short and long term goals of the program to start upward range site condition trend on these rangelands, includes first gaining the understanding and cooperation required at especially decision-making levels to meaningfully implement and maintain the Grazing System.

L. Recommendation

It is recommended that the Range Development and Grazing System Plan be implemented provided mutual awareness of the need for professional level range management is understood. Some points of this understanding include

1. That stability of the investment in Rangeland development in the project area is dependant primarily on the enhancement and stability of the Rangeland Ecosystem upon which all of the enterprise is dependant.

2. That stability of these Ecosystems with increased and continuing grazing use is, in addition to meeting the guideline stocking by issuing permits, dependant on carrying out the long term grazing schedules which include regular deferment and rest periods as a key ingredient in the Grazing System.

3. That maintaining long term stability of this fragile range environment with optimum and stable livestock production consistent with other uses of the range and cropland is a responsibility of the Range Management Division of the Ministry.

4. That a high level of team interaction performance be maintained between the Lake Chad Basin Commission, US/AID and other donors to carry out the Grazing System Plan. This should include participating in monitoring and inspections to help insure that grazing schedules are carried out; and that group-problem-solving technique-training be maintained as a regular part of the inter-team action.

5. That the key action and measure of progress will be to adequately carry out an integrated Rangeland-cropland Grazing System on the land, thru the people, for the first 12 year period and then repeating the process only as modified by a range site and livestock production evaluation in depth, at that point in time.

6. That a top quality short and continued long term seminar type training program be provided and coordinated thru joint donor effort and expertise; and that these seminars and other top quality training media be directed first toward creating awareness of the need of strong Divisions of Range Management staffed as quickly as possible by highly trained and experienced professional level Range Managers.

7. That the difficulty of developing adequately trained and experienced top and middle management people may be the most difficult and necessary task at the outset; because actual response of the herders to adequately carry out the Grazing System will be almost wholly dependent upon the professional capability of top and middle management people working in both the short and long term with Range Association leaders on the land.

8. That awareness of the need for highly trained and experienced African people to meet this measure of capability, be demonstrated thru providing professional and sub-professional training in Range Management;-leading to at least a Bachelors Degree in some universities in West Africa and that training and recruiting of candidates be chiefly focused on people from low-rainfall cattle producing zones, or backgrounds.

9. That inventories of adjoining rangelands be continued and designed and implemented into Grazing Systems as soon as similarly effective extension can be also directed to those rangelands.

10. That a strongly trained and experienced Range Management Specialist in planning and implementing Grazing Systems on semi-arid rangeland Ecosystems be added to the Chad Liaison staff.

11. That the Fire Management job be agressively challenged on the Project area and that in addition to also maintaining management lines for that purpose that they be further maintained in certain strategic locations for fire control; in addition to developing an effective fire prevention, presuppression and suppression program. In addition to other budgets, it is recommend that $15,000 be directed annually to each sector for the above tasks and including equipment and material.

M. This project will be difficult. So far as this team is aware there are very few if any successful long-term livestock enterprises implemented in the "lower rainfall" Sahel-Sudan zone in the project vicinity. Because of the formidable environmental and cultural disciplines apparent, however, a successful demonstration of a Range Development and Grazing System in this zone can exert a favorable impact on the people and rangeland environment perhaps for the first time. This can provide rare benefits for the substantial numbers of people on this project area. It can also serve as a pilot demonstration area for a very great number of people dependent on similar rangeland in the Sahel Sudan zone. In the continued absence of adequate Grazing Systems, the Rangeland Ecosystem with the quality of life of the people who live and depend on it, will continue to deteriorate.

N. If or when decision-making bodies for the Asrale-Serbeouel Project area request additional well construction for livestock use, ahead of provisions for adequate Range Management, the need for greater emphasis on extension effort at that level, will continue to be documented.

E. Specifics

A separate alternative Range Development and Grazing System Plan covering only the part of Grazing Block D located north of the Chad-Nigeria road, is also included in the Grazing Block D Graphic section binder. This is to accommodate comparison of the present proposed plan with certain concepts evident in the November 19, 1975 meeting of livestock men and government leaders in Makari. Some representatives at that meeting wished to limit the extent of the planning area of the Serbewel Sector to only that part of the present Grazing Block D, north of the Chad-Nigeria road. Grazing Block D, as proposed, generally coincides with the south boundary of the Resource area I ("north part of the Logone-Chari Department") as classified and mapped in the report titled "Resource Inventory of North Cameroon" prepared by the joint USAID-FAC team in 1975.

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Following a briefing/the Lake Chad Basin Commission officers' meeting in N'Djamena, on December 5, 1975, by the team members, on the Range Development and Grazing System Plan, the response appeared to be supportive. Two proposals to adopt such an approach in range management were made to the Chair. No action was taken on these proposals at that time although there appeared to be no obvious resistance to the overall proposed plan design or guidelines. There was discussion again on inclusion of rangeland south of the Chad-Nigeria road. The meeting was advised by the team members that Grazing Block D (alternate), which limits the Block area to that portion located north of the Chad-Nigeria road only, had also been included in the Plan for further study of the option by the Commission.

In the planning process, the pasture numbered W-2 of Grazing Block A was designed to utilize the water supply provided by the artesian well recently constructed at that location. Likewise pasture number D-6 of Grazing Block B was designed to utilize a second artesian well also recently constructed at that location by the Lake Chad Basin Commission cooperatively with USAID. These two wells can be utilized to carry out the Range Development and Grazing System Plan designed for those respective pastures and Grazing Blocks. These wells will not contribute to deterioration of the rangeland when the grazing system is implemented and carried out as planned.

F. Contacts

A number of representatives of the Lake Chad Basin Commission, FAC, UNDP/FAO and Chad and Cameroon Governments and USAID Mission officers were met by the team members. A list of some of the people contacted is attached.

C. Acknowledgements

The team wishes to express its sincere thanks for the splendid assistance provided in background information, counsel, guidance and hospitality by Drs. Tonwe, Ngaba, Crouail of the Lake Chad Basin Commission and Gaston of the Farcha Laboratory. Acknowledgement is also certainly due Dr. and Mrs. Garrouth and Scotty and Mrs. Deffendol for their hospitality in the field and to John Koehring for his counsel and guiding service at the outset.

The team is also very appreciative of the sincere efforts of the Chad USAID Mission Director John Lundgren and staff for their providing timely support, secretarial service, transportation, housing, etc. and the very fine courtesy in N'Djamena.

II. Description of the Grazing Unit

A. Location: This unit extends from the south shore of Lake Chad southerly to Fotokal, Gouima, Farcha, Djermoy and Massaguet.

B. Size: It comprises approximately 999,370 hectares (approximately 2,468,500 acres) of which 193,500 hectares may be innundated by Lake Chad in some years but excludes approximately 105,000 hectares which is now above Lake Chad shoreline at the present water level and is available to livestock. The size of the grazing unit is assumed to be the approximate average area of rangeland which will be available for grazing. This is subject to correction as documentary information is made available.

C. Topography and Soils:

The topography is all relatively flat.

The two large soil type categories represented are "sandy steppe-like" and "temporary hydromorphic." The latter are "sandy to sandy clay," and "alluvial sandy silty" with subtypes which may be alkaline.

The "Astrological Report" of Dr. A. Gaston (1974) and the "Resource Inventory of North Cameroon" by the joint USAID-FAC team (1975) provide detailed information on the topography, vegetation and soils of the project area.

D. Climate:

The unit is situated in the "Sahel-Sudan" area which is characterized by a single rainy season from June to September. It is situated between 400 and 600 mm isohyets. See page 5a.

E. Vegetation:

The present vegetation varies from shrubly steppe with thorn-bushes to moderately dense shrubby steppe all characterized by long term impacts of livestock grazing and cultivation and mostly deteriorated to annual grasses in "low fair" to "very poor" condition. There are for instance over 25,000 hectares of strongly eroded clays. The potential plant community is predominantly a natural savannah characterized by the perennials Andropogon gayanus, and Hyperrhinea dissoluta and arrufa with Setera pallidifusca, Setaria sermunis. This type in a broad sense is interposed with types characterized by more hydromorphic potential types dominated by such perennials as oryza sp., Cynodon dactylon, Pennisetum, Brachiaria ramosa and others. Relics of perennial species persist on range sites behind aged barriers where they are still protected from heavy grazing during the growing season and from cultivation damage.

The present total dominant annual grass species provide very small and shallow root systems and thus dry up quickly following the rainy season. There is thus a serious shortage of root fibre to resist wind and water erosion and thus hold the top soil in place. There is also a diminishing supply of nutrients in the shallow top soil no longer fertilized by deep and extensive root systems of perennial plants. For this and other reasons there is a serious shortage of nutrient content in the forage from annual grass plants in the dry season. Livestock are thus more heavily dependent on browse from trees and shrubs during the dry season on these poor condition ranges than would be the case on good or fair condition rangeland.

In his astrological report Dr. Gaston provides a great deal of information on nutrients to be found in grasses and browse in the project area and its significance to livestock production. There is also a wealth of information on the character and annual forage production(dry weight)on the many types found in the A. sale-Serbewel zone and how it may be applied in arriving at grazing capacity.

The methods appear to be consistent and quantity data from that report is utilized as a basis for beginning guideline stocking in the grazing system proposed in this report.

RAINFALL RECORD Lakary/Cameroon (monthly for 7 years and averages)

	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Jan	Feb.	March	Total M.M.	Total Inches
1969 (23 days)	0	21.8	54.8	53.4	108.6	139.1	0	0	0	0	0	0	377.7	14.87
1970 (29 days)	0	15.7	0	74.8	117.2	305.3	0	9.8	0	0	0	0	522.8	20.58
1971 (26 days)	0	96.1	0	45.4	141.6	41.8	0	0	0	0	0	0	324.9	12.79
1972 (29 days)	0	21.9	30.5	21.1	103.5	55.0	0	0	0	0	0	0	232.0	9.13
1973 (24 days)	2.0	18.5	30.5	78.0	192.5	106.0	7.0	0	0	0	0	0	448.1+	17.64
1974 (28 days)	0	5.5	10.0	148.2	160.0	39.0	17.0	0	0	0	0	0	385.7	15.18
1975 (23 days)	0	0	37.4	100.4	160.7	87.5	0	0	0	0	0	0	460.0	18.11
Total 7 yrs =	2.0	169.5	175.2	587.9	999.1	772.7	24.0	9.8	0	0	0	0	2771.20	
Ave 7 yrs	.28	24.2	25.0	84.0	142.7	110.5	3.4	1.4	0	0	0	0	391.6	15.42
i.e. low. (7 yrs)	0.0	0.0	0.0	21.1	103.5	39.0	0.0	0.0					163.6	6.44
	Rainfall Record N'DJAMENA (monthly and annual Average for 41 years)													
	8.2	31.3	63.1	157.1	243.4	183.4	19.0			-	-		725.5	
	Rainfall Record N'DJAMENA 1973 (year of Agrostological Study)													
	1.9	15.8	18.7	59.3	116.8	100.5	0.0	0	0	0	0	0	312.5 *	

* Comparison shows 1973 as year of lowest rainfall in N'Djamena (about 50 % of 41 year averages) while in same year Lakari experienced above 1 year average amount of rainfall. This indicates typical low-rainfall sub-Sahara "spotty" rainfall volume pattern rather than predicable volume of precipitation from seasonal storms.

A discussion of vegetation and range management concepts directed to North Cameroon rangelands (including the Serteouel sector) is presented in the paper titled "Resource Inventory of North Cameroon" by the joint USAID-FAC Team (see list of references). Because that report covers the views by this team, we are quoting excerpts on these topics from that report as a part of the Appendix of this report in order to avoid duplication in writing this phase. It is suggested that these excerpts be read at this point in this report to maintain continuity of views on this subject before preceding farther in reading this report.

III. Objectives

A. General The basic objective of this Range Development and Grazing System Plan is to provide a pilot Range Development and Grazing System Plan to be implemented on a "Sahel-Sudan" nomadic rangeland village cropland related ecosystem to improve and stabilize the quality and quantity of the ecosystem's benefits for the people.

Gaining participant commitment to this need and process thru their direct involvement in its successful operation must be a vital part of the objective. This means that the key operation's objective, at the outset, places highest priority on appropriate and timely extension effort at all levels with emphasis on the Project's pilot dimension.

Because of programs already initiated in earlier project activity the objective must include, as a minimum, the implementation of a Grazing System that will not further degradate the fragile rangeland ecosystems which characterize this low rainfall zone. This will mean maintaining satisfactory forage production on all areas being developed and to improve and maintain production on areas in close proximity to water to stop the doward range condition trend which now especially characterizes the land in close proximity to all natural and developed water points observed. This can only be brought about by increasing and maintaining the vigor, density, composition and forage production of plants on these lands by carrying out adequate Grazing Systems.*

* Foot note

A Grazing System is defined in the 1974 edition of the "A Glossary of terms used in Range Management" published by the society for Range Management as: "A specialization of Grazing management which defines systematically reoccuring periods of grazing and deferment for two or more pastures or management units".

B. Methods.

Methods will consist of first implementing extension, and organization development action, while correlating the village agricultural enterprise with the potential of the adjacent rangelands suitable for the village livestock in a sustainable Grazing System. The next step will be correlating this need with the Grazing System prescribed for the Grazing Block. This will eventually consist of distributing livestock to certain parts of the Grazing Block in proper season so that the livestock can make optimum gains and so that key desirable forage plants, after being grazed on schedule, can regain their full vigor before being grazed again. The various parts of the Grazing Block are arranged into Management units which will be called pastures. These will need to be located on the ground thru the Association and must be marked on the land by a road or vehicle track or paint or post line and maintained so that the marked line can be readily identified by herders. After the essential facilities for management, including adequate organization and extension, is developed at all administrative levels, and the herding schedule and sequence within the marked and designated pastures in a grazing Block Plan, is clearly understood by leaders and agreed to, then water can be developed to more effeciently utilise the forage. Thereafter the system for a Grazing Block can be implemented. Most livestock owners will likely herd their livestock first within schedules in the village Grazing System and agriculture plan in the early wet season. Each will need to meet it's responsibility within the overall Grazing Block Plan thru following the schedule to be provided by the village community Range Association working with the Grazing Block Manager. Every effort will need to be made to carry out the practices in accord with the people's culture, while maintaining essential control of livestock moves to defer grazing on certain pastures, and yearlong rest from grazing on others as designated in the grazing schedule. The Grazing Block Manager working with the community and village Range Association in the Grazing Block, will be expected to modify plans to meet emergency weather condition. Variances from the regular schedules will be expected to be held to a very minimum. The scheduled deferments and rest periods designated for specific pastures will need to be followed by all, or the system will not provide the benefits intended.

IV. Present operation and ethnic methods

A. The traditional herdering pattern

Cattle are presently herded close to the villages(which are scattered over the entire grazing unit - see graphic section overlay N° 3) during the wet season. The villages that herd

livestock ("stoto villages usually do not) are usually situated on or adjacent to emerged rangeland soils. On this they usually have some wet season grazing and water which may be sufficient to carry their stock during the 4 months period of the average wet season. They are usually short on forage and water for the average [illegible] "8 months" dry season period and are obliged to either develope water and harvest and store forage for the dry season or "transhume" (move their cattle and usually their village to where is water and some forage during the dry season).

The livestock is generally accompanied by a herder when it is out of the village. Cows are herded back each day for milking and feeding small calves (which are held in or close to the village) and for protection against flies or theft. They are usually penned in a house during the heat of the day and are herded to fallow rangeland outside the village late in the day and early morning. Livestock other than adult cattle tend to be herded closer to the village and in more irregular patterns.

During the dry season livestock grazing is usually limited to within a radius of 10-20 kms of Lake Chad or the Chari, El Beid, and Serbewel River sources, except where dug wells exist. (Location of existing wells and other water sources in dry season is shown on Graphic Section overlay N° 2). Much of the rangeland included in the Grazing System is flooded area and unusable during the wet season. Substantial numbers of livestock (the total number of which may vary considerably eachyear with the "temporary" rangeland area periodically made available for grazing or inundated by Lake Chad) "transhume" to the "Kaeres" zone (situated south of the Chad-Niger a road) which is mostly flooded during the wet season but used by livestock from several sources during the dry season.

B. Livestock

1. General

Detailed reports on livestock and the production for the Ansalo-Serbewel Project area is described in several reports included in the attached list of references.

In summary, the livestock consist of cattle, sheep, goats, donkeys and horses and an occasional camel.

Over 90% of the cattle are Choa (shortho.n) Zebu breed of fair quality. The remainder of the cattle are mostly crossbred Kuri-zebu and Kbombre (red longhorn) breed.

Sheep are mostly Choa Arab breed with a few Fulbe. These are an intermediate strain between the "long legged" desert sheep and the short legged variety common to the high rainfall zone. All are hair sheep. Goat breeds are not specifically identified. Some desert type sheep("Arab and

"Zoghawa") and goats, cross the area to market from Niger and Chad.

2. Tropical Bovine Unit

The bovine animal adapted by Dr. Gaston for his study and capacity projections is described as an adult bovine of 250 Kg live weight represented by the term U.B.T. (Tropical Bovine Unit). For planning purpose here other animals have been related to "UBT" as follows

1	UBT	=	1 cattle
1	"	=	7 sheep
1	"	=	7 goats
1	"	=	1 donkey
1	"	=	.7 horses

3. Calf crop and off-take

Some pest control and veterinary services had been extended to the grazing unit during the early 1960's. Additional Tse-tse fly programs and veterinary services provided thru the early program effort has further improved the health and the vigor of the animals so that by 1974 the herd composition was significantly improved and the mortality lessened. Reports indicate that during the period 1971 thru 1975 the cattle numbers increased in the Serbeouel sector by 14,4 %, goats increased 68,9 % and sheep increased 80,8 %.

With adequate management of the rangelands in addition to measures provided to the livestock, it is estimated that the annual off-take of the animals can increase from 7 % to 14-15 %. It is also expected that calf mortality will be reduced from 40/50 % to 25 %. Calving rates are expected to increase from 40 % to 60/65 % per year. Animals will mature in 3-4 years rather than 6 years as at present. Calf crops of about 55 % have been reported for 1974 and 1975 as compared with 40 % at projects start. All of these livestock gains, and in fact even the few benefits that could be realized in the pre-assistance period, are all dependant on a stabilized forage supply. All animal gains will deteriorate with the deteriorating rangeland and be mostly lost within a relatively short period; unless Grazing Systems are implemented which can and will stabilize the forage supply of the range resource. Grazing Systems must be designed and carried out in both the short and long term that will increase instead of decrease the Rangeland Ecosystem benefits.

4. Livestock census

It is estimated that over 118,000 head of cattle, 75,000 head of sheep and goats and 3 thousand head of donkeys and horses graze on the Serbeouel

sector. A total of approximately 45,000 head of cattle plus slightly over 20,000 units of sheep and goats, donkeys and horses in about the above proportions are estimated to presently graze in the Assale sector. Approximately 30,000 head of the cattle grazing the Assale sector are owned by totally nomadic people from farther east and north. These graze on the sector only during the dry season. They then occupy most of the immediate Lake Chad shoreline and vicinities.

The cattle herd managed by a single herder will vary in size mostly from about 50 up to 150 in wet season and from 50 to 80 head in the dry season. It is estimated that the average cattle grazed by an individual owner is about 13 herd of cattle plus some sheep and goats and possibly a very few donkeys and sometimes a horse.

V. Range condition and trend

1. General

The condition of rangeland as inventoried by the Dr. A. Gaston Study and as verified by field checks is badly deteriorated, except in some of the "Yaeres" zone. All of the grazing unit is considered in low fair to very poor condition except those relatively small areas limited to strictly dry season grazing by regular deep flooding and low depression seeps. On such sites the desirable perennial grasses are thus deferred from grazing every grazing season and have thus maintained more vigor, density and higher forage production because livestock cannot graze the plants until the water recedes. Many of these regularely flooded sites have however also been deteriorated by excessive trampling near the receding water bodies. This later appears to be caused by local excessive stocking where the relics of the most nutritious forage species especially attract excessive livestock numbers under very competative conditions. Native vegetation on some periodically flooded, are also depleted or completely denuded by cultivation. Areas which are in the immediate radius of wells and most village vicinities consistently show extensive trampling damage; in addition to badly depleted species composition, density, ground cover and mulch requirements.

2. Forage production

One of the key criteria for documenting range health is evaluated from measurements of seasonal production of livestock feed in terms of Kg per hectare (dry weight) based on measurements shown in Dr. A. Gaston's 1974 Aerostological Report. The measure of condition is based on the condition and production compared with that for which the land is capable of producing (i.e. the potential under adequate management). Indicators of very poor, poor and low-fair condition range and downward condition trend is documented by the total absence of or very low vigor of key desirable grass species,

absence of new plants of key desirable species; excessive wind and water erosion on bare or partly bare areas of the "A" soil horizon; current excessive trampling and excessive cropping near water points and dominance of low producing Annual grasses. The areas which have been available to continuous selective livestock grazing during the growing season for about ten years or more are in very poor condition. In addition to the "Yaeres zone", some widely scattered relatively small areas subject to very short and irregular or no grazing due to protection by inundation during the growing season and spared from cultivation, remain in high fair or good native range condition. These are rare however over the area as a whole.

The potential plant community is a natural savannah dominated by Andropogon gayanus, Hyperrhenia rufa, Setaria pallerifusica, Setaria communis with various densities of acacia trees and others. The present plant community is primarily Annual grasses with acacias trees and shrubs. Present production on these range sites is 500-1000 Kg per hectare of mostly annual grass species as a general condition. The potential under adequate management is 1500-2000 Kg per hectare or more, made up of predominantly perennial species. The desirable perennials have deep roots which penetrate several feet to moisture and thus remain green longer into the dry season. This provides greater quantities of needed nutrients for foraging livestock especially in the dry season.

On the highly alkaline eroded clays, the potential plant community is a natural savannah characterized often by Hyperrhenia rufa and Eragrastris pobgina as the dominant species. The present plant community is primarily Annual grasses with low nutrients value in the dry season, and acacia trees. Present production is estimated at 100-500 Kg per hectare while the potential is 500-1000 Kg per hectare.

The range Development and Grazing System plan is designed to start upward condition trends toward restoring the potential production capabilities of the integrated range and croplands.

VI. Stocking Guidelines

The Beginning Stocking Guidelines for each Grazing Block on the project area and the Grazing Unit total is shown on page 11a and in the Graphic section overlay n° 4 and part n° 7.

The basis for the calculation of grazing capacity was mostly developed from forage (dry weight) measurements and animal requirement studies reported by Dr. A. Gaston in his Agrostological Reports. Forage weight measurements were collected from all vegetative types comprising the project area. Estimated total available production was calculated from the study data for individual pastures and Grazing Blocks.

Summary of Hectares of Rangeland and Indicated Average present "TROPICAL BOVINE UNIT" Capacity, by Grazing Blocks

(also shows Separation of areas periodically inundated by Lake Chad, by seasonal flooding, and in fallow)

Block	Total Hectares in Block	Indicated Maximum Unite Capacity	% of present herd	Indicated Ha. per unit max. capacity	Area Subject to periodic inundation by Lake Chad and shown as types "AER" or "SER" on Type Map of LCBC (Gaston) Nov. 1974 and included in grazing System Plans as "Average Usuable Rangeland" (Hectares)	(Units G.C.)
(Serbecual Sector)						
A	[illegible]	30750			51,325	(34,[illegible])
B	43300	8700			4,000	(270)
C	183525	16000				
[illegible]	1[illegible]2000	36000				
D alternat.	(63075)	(13800)				
TOTAL Serbecual	436250	92150	71. on 130,000	5.4	55,325	(3,770)
TOTAL w/ "D altern." only	([illegible]325)	(69250)	53.3	5.6	(55,325)	(3,770)
(Assale Sector)	[illegible]	(30000 units 260 days only) 2[illegible]00			138,195	(9,200)
[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	18[illegible]0				
[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	13650				
TOTAL Assale	553120	70200	140.1 on 50,000	7.1	138,195	(9,200)
Total Assale-Serbecual Project Area	939370	162350	90%	6.1	193,520 = Grazing capacity included grazing system (at 10 ha unit 260 days) = 12900 un	
w/Block D Altern.only	(889450)	(139950)	77.7%	6.4		

Continuation see following page

Summary of Hectares of Rangeland and Indicated Average present "TROPICAL BOVINE UNIT" Capacity, by Grazing Blocks

(also shows Separation of areas periodically inundated by Lake Chad, by seasonal flooding, and in fallow)

Block:	Total Hectares in Block	Indicated Maximum Unite Capacity	% of present herd	Indicated Ha. per unit max. capacity	Area Subject to periodic inundation by Lake Chad and shown as types "AER" or "SER" on Type Map of LCRC (Gaston) Nov.1974 and included in grazing System Plans as "Average Usuable Rangeland." (Hectares)	(Units G.C.)
(Sorbecual Sector)						
A	[illegible]	30750			51,325	(34,[illegible])
B	43300	8700			4,000	(270)
C	182525	16000				
E	142000	36000				
D alternat.	(63075)	(13800)				
TOTAL Sorbecual	430250	92150	71. on 130,000	5.4	55,325	(3,770)
TOTAL w/ "D altern." only	(366325)	(60250)	53.3	5.6	(55,325)	(3,770)
(Abeche Sector)		(30000 units 260 days only			138,195	(9,200)
	[illegible]	24400				
	[illegible]	[illegible]				
G	[illegible]	18650				
	[illegible]	7200				
I	[illegible]	13650				
Total Abeche	503120	[illegible]	140.1 on 50,000	7.1	138,195	(9,200)
Total Abeche-Sorbecual Project Area	[illegible]	152250	90%	6.1	193,520 = Grazing capacity included grazing system (at 10 ha unit 260 days) = 12900 un	
w/Block D Altern.only	(889450)	(139950)	77.7%	6.4		

Continuation see following page

C O N T I N U A T I O N --- Summary of Hectares of Rangeland and Indicated Average ...

Block	Area subject to periodic inundation by Lake Chad and shown as types "AER OR SER" on Type Map (Nov. 1974) but in a lower elevation zone closer to the Lake and more subject to inundation. This mostly available for grazing in 1975 but not included as basis for average capacity. (Hectares)	(Units G.C.)	Area seasonally flooded by sources other than Lake Chad (H, L and "F" Type Series)	Area shown as "Fallow" (C) on Type Map. Assumed that 70% of this not actually occupied by crops at given time.
Sertoeuel sector)				
A	34000	(2300)	24,875	21,000
B			2,250	8,200
C			34,125	3,400
D			104,500	35,625
E (Kaiti)			(16,000)	(20,700)
Total Serteoeuel	34000	(2300)	166,050	78,175
Total w/ "D alterm." only			78,350	(66,000)
Angale sector				
H	71000	(4700)	7,425	1,500
I			4,925	175
G			9,525	12,875
H			175	150
I			75	12,700
Total Angale	71000	(4700)	22,125	27,400
TOTAL Angale-Serteoeuel Project area	105000 = Lake Chad shoreline presently available rangeland subject to higher risk by periodic inundation and thus not included in grazing system (at 10 hectares per unit for 260 days = 7000 units)		188,175	105,575
w/Block D alternat. only			(100,475)	(93,400)

The "Tropical Bovine Unit" requirement for 105 days wet season grazing was averaged at 1,960 Kg dry weight per hectare.

The Tropical Bovine Unit requirement for 260 days dry season grazing was averaged at 4,200. Kg per hectare. This latter included an estimated 20 % loss allowance for fires, spot droughts, wind carry, breakage, tree and shrub cutting and wildlife needs.

Because a very high percentage of the grass forage is comprised of annual growth which is relatively fragile and of low nutrient content during the long dry season, the team is inclined to assume that the beginning guideline stocking figures set forth are more likely to be high rather than low, under the grazing System designed. This is especially true if the average bovine unit on the range developes thru the improvement programs into a heavier animal requiring a higher daily forage consumption than now calculated for the "Tropical Bovine Unit".

The range inventory for the Assale sector indicates in theory that some additional grazing capacity may be available there. It must be recalled however that there is virtually no rangeland in that sector that is not already badly deteriorated from a long history of continuous selective grazing and that the vigor and density of the key desirable grasses is nil. The potential production of forage and livestock on the sector can very likely be improved more rapidly by conservative stocking. It is therefore recommended that the stocking be held to the present numbers on the Assale sector thru the first 3 to 6 years of fully implementating the Grazing System and thereafter adjust the stocking as is indicated.

Control of stocking to within about 15 % +- will need to be mandatory under this Grazing System. Natural "controls" will not be adequate. Without positive numbers control the Grazing System cannot be successful. A permit system for authorizing numbers of livestock to be grazed annually in addition to carrying out the grazing schedules for deferment and rest will be a prerequisite for success of this Grazing System.

Beginning guideline stocking for the total Grazing Blocks N°1 thru N°9 as shown in the summary table (page 12) is estimated at 162,350. If Grazing Block D (Alternate) is selected instead of D then the beginning guideline stocking is indicated to be 133,750. Reference is made to factors discussed in the introduction pertaining to the reason for the alternative plan for Grazing Block D.

It must be emphasized that these are guideline projections. Actual capacities on the semi-arid rangeland will be mostly dependent on how closely the Grazing System requirements for deferring and resting pastures as scheduled are carried out with livestock numbers matching guideline figures for beginning trials. If the scheduled deferments and rest schedules are not carried out, a further reduction of at

least 30-40 % will very likely be necessary to avoid a rapid deterioration of the range as can be expected following water development if selective season long grazing was permitted to continue. If the scheduled deferments and rests are carried out as indicated in the plan, it will very likely be possible to increase the stocking to some degree within ten years after total implementation. The grazing capacity in this semi-arid range will always be dependent upon the season by season weather conditions. The most stable stocking guideline is the one that will match the stocking capacity determined thru actual experience for the "average bad year". By holding to this stocking guideline the potential higher rangeland production can be restored more rapidly in the better than "average bad years" if the plan schedules are carried out every year. In addition the available grass-vigor reserves and forage available on pastures otherwise scheduled for yearlong rest will be available to prevent losses in the worst drought years.

Over or under stocking will be currently identified by the Grazing Block manager thru current monitoring of the results of grazing impacts on the rangeland. His major responsibility in this regard will be to note why the over or under stocking at a given point occured and to always correct the situation by current adjustments if he can. Overstocking can be usually identified promptly if excessive trampling is evident near water holes or village, or and where livestock run short of forage or water before the end of the scheduled grazing period in a specific pasture. His responsibility must always include prompt "follow-up" with the herders to see that the schedules are accomplished in a satisfactory manner on the range.

If after 3-6 years of carrying out the deferment and yearlong rest requirements on the pastures designated for that treatment, there is evidence of continuing excessive trampling, especially near the water points, or if livestock are consuming all of the food or water in a pasture before the scheduled time to expand grazing into another area in accord with the grazing schedule, the stocking will likely need to be reduced in those specific pastures.

If the Grazing System and beginning stocking guidelines are carried out as scheduled for a six-year "go round" it is likely that the livestock production benefits will increase thru increased off take of better animals and improvement of the rangeland ecosystem health. The manager will document range site condition and trend with photo grid-plot transects to be reread at no greater than five-year intervals.

VII. The Grazing System: applying a Grazing System tailored to the environment.

A summary of some of the more common rangeland functions and factors which must be accommodated in implementing a Grazing System on semi arid rangeland which can stabilize and improve the forage and livestock production, is outlined on the chart on the following page.

A. Grazing treatment and livestock management.

The heart of each Grazing System for each Grazing Block consists of accomplishing herding controls, the schedules for which are to be provided by the Range Associations working with the respective Block Managers within the overall guidelines of the Grazing System. The measure of herding control necessary will be that required to withhold grazing certain designated pastures until on or about the deferment date stated in the plan, and to exclude livestock (other than those otherwise managed in village plans) from pastures to be rested yearlong as scheduled.

The herding necessary to meet the deferment schedules can be accomplished by the herders in simple expansion steps by dates into the areas to be grazed by the livestock in a particular sequence. The approximate date for expanding grazing into additional areas will be provided in the grazing schedules. The herder must be clearly aware of his grazing schedule so that he will always know how to properly carry out his part of the plan.

The instructions to herders pertaining to this, must always be simplified for workability by the Block Manager, working with the Range Association thru its field representatives and water attendants. They must avoid confusing herders with conflicting information by being sure that each traditional territorial leader of herders knows clearly where livestock can be grazed and the dates when the livestock are authorized to expand into additional pastures. The plans must be delivered in sufficient time for the leader of the herder groups to keep people informed without haste and disruption.

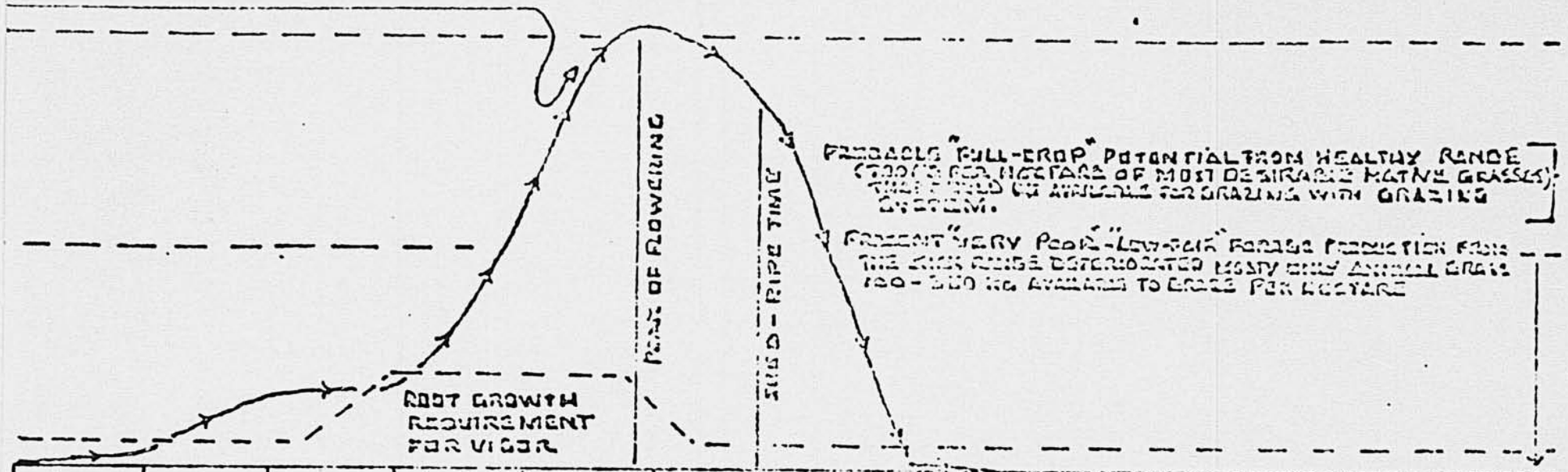
Developing and maintaining organization and communication channels so that leaders of herders will be properly briefed at all times is as much a key responsibility of the Block Manager for its success as is the herder's. In actual practice the Grazing System carried out on an individual Grazing Block will be carried out as successfully as the Grazing Block Manager accepts. The shortcomings of performance therefore is as likely to be chargeable to the manager's shortcomings in organization and extension expertise as to anyone else. He must really relate and operate with the livestock owners as a sincere and motivated leader of his profession over the long term

SOME RANGELAND FUNCTIONS AND FACTORS THAT MUST BE ACCOMODATED IN THE ASSALE - SERBEDUEL PROJECT.

WHEN PLANNING LONG TERM ECOSYSTEM STABILITY IN TROPICAL SEMIARID CLIMATE WITH ONE GROWING SEASON ANNUALLY IN HABITAT OCCUPIED BY SEDENTARY AND SEMI-SEDENTARY - NOMAD LIVESTOCK AND VILLAGE CROPLAND GROWERS:

- PROBABLE TOP-GROWTH AND RATIO OF DIGESTABLE NUTRIENTS - LIVING OF DESIRABLE GRASS SPECIES - POTENTIAL.
- CARBOHYDRATES LIKELY CONSUMED BY KEY GRASSES - POTENTIAL GROWTH ANNUALLY — FOR GROWTH-ENERGY REQUIREMENT
- CARBOHYDRATES LIKELY STORED BY KEY GRASS PLANTS TO START AND PROMOTE FORAGE GROWTH NEXT YEAR.
- DAILY GAINS ON CATTLE (KG PERIOD PER DAY) WILL LIKELY TEND TO FOLLOW SAME RATE AS KEY FORAGE GRASS GROWTH LINE

GRAZING DURING THE GROWING SEASON "DESTROYS FOOD" FOR CATTLE PRODUCTION INCREASES.
GRAZING DURING THE GROWING SEASON ALSO DESTROYS FOOD IN DESIRABLE GRASS PLANTS — UNLESS ADEQUATE PERIODS OF REST FROM GRAZING ARE PROVIDED AND EARNED BY THE GRAZING SYSTEM.



APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT.	NOV.	DEC.	JAN.	FEB	MAR.
.29	24.2	26.0	84.0	42.7	110.5	2.4	1.4	0	0	0	0

PERIODIC DEFOLIATION NOT TO BE VERY LIKELY NECESSARY FOR MAINTAINING SOIL →

1) DEFOLIATION WILL VERY LIKELY BE NEEDED TO MAINTAIN →
IN CERTAIN LOCATIONS FOLLOWING TWO CONSECUTIVE YEARS OF GRAZING IN GROWING SEASON.

A VILLAGE GROWING LIVESTOCK
L THEREFORE NEED TO CARRY
A GRAZING SYSTEM THAT
L PROVIDE THE DEPARTMENTS
PERIODS OF YEARLONG REST
NEEDED TO MAINTAIN (AND
IMPROVE PORTABLE FORAGE STOCKS.

VARIED GRAZING PRACTICES WILL BE NECESSARY TO MAINTAIN AND RESTORE THE VIGOR, DENSITY PLANT SPECIES COMPOSITION, AND THUS FORAGE AND LIVESTOCK PRODUCTION ON DETERIORATED [illegible] RANGELAND, ESPECIALLY [illegible]

The four steps controlling the area expansion dates of the Grazing System are as follows (there are no other steps. When the herder has accomplished these steps he has carried out his part in the Grazing System).

Step 1 Graze livestock within the individual village agriculture and Grazing System plan to the extent the ecosystem will permit a balanced deferred Grazing System within the village vicinity, suitable for grazing in the wet season.

Step 2 In the early wet season (starting about June 25) livestock over and above the permitted numbers able to graze in a balanced plan in the village vicinity will be integrated into the Grazing Block Grazing System. These livestock will thus start to graze in the pastures designated for grazing in the "early wet" season (shown in dark green in the Graphic section part n° 5) for the appropriate year, just as soon after the rainy season starts as there is enough green forage and water on these pastures to carry the livestock.

Step 3 When (after about Aug. 20th) these livestock run short of forage or water in the "early wet" pasture where they started grazing earlier, they may then expand into those pastures which have been scheduled for early deferment (colored light green on overlay n°5 in the Graphic section) where water and forage are planned to be available. At the same time, keep the livestock out of areas scheduled for rest yearlong (other than on village vicinity areas situated within the agriculture and Grazing System plan.).

Step 4 After about September 25th expand use into the dry season pastures.
Where livestock have adequately consumed the forage or water in the wet season pastures then the livestock may expand the "dry season" grazing areas (colored yellow on part n° 5 of Grazing Section) where forage and water are planned to be available until the following June.

By holding his permitted number of livestock on pastures designated for grazing until expansion into additional pastures is scheduled in the plan, the herder is carrying out his responsibility to create a favorable situation to produce more and better forage and red meat on a then stabilized rangeland. From this point on, the herder has

only to accomodate his animals and the instructions which may be forth coming from the waterpoint custodians (see range improvement section) and then "let things happen". Range site conditions will then tend to improve with time, because then "nature" (ecological response) "will tend be on the herders side".

Beyond these steps explained above, the responsibility of the livestock owner is to work with the water point custodians and the field representatives of his Range Association and to take good care of his livestock. This latter will mean keeping the livestock in good grass, plenty of water free from bad ticks, flies and desease with a minimum of disturbance to otherwise traditional practices.

B. Grazing Blocks are designed into "pastures".

In the sequence of grazing treatments scheduled for each of the designated "pastures", at least five of the six [illegible]. "pastures are scheduled to be grazed in the appropriate season each year. Certain areas which constitute not more than 17 % of the rangeland area are rested from grazing yearlong each year and are different areas from one year to the next. In this way plant vigor and eventually soil conditioning and density of desirable forage grasses is restored on each pasture. The areas designated for yearlong rest in the wet season pastures are mandatory because there are absolutely essential to the restoration of these pastures. The dry season pastures are scheduled for rest once every six years. Because deferment is afforded these dry season pastures every year, this scheduled rest is not mandatory. Therefore if an emergency did arise such as if Lake Chad flooded to its all-time high shoreline, or catastrophic fires occur, or prolonged critical drought conditions occured, or to help absorb the temporary damaging impacts of excess stocking during a 2 year stocking reduction program, it could and would be grazed. Then the dry season pasture wihich is scheduled for yearlong rest under normal conditions would be grazed under a special one year authorization. That pasture would be provided yearlong rest promptly at the emergencies' end.

Pasture boundaries may be marked in any manner that can be unmistakably identified by the herders. A grader-blade track, hand clearing, painting on trees, or posts can be acceptable for given circumstances. The pasture lines marked on the overlay are intended to follow existing roads and tracks in that vicinity which can be rerun and marked when necessary. In most instances where lines do not follow marks now on the land it will be necessary to work out agreeable locations for pasture lines with local leaders and then mark the lines.

C. The Grazing formula

The grazing formula prescribed for each Grazing Block is designed to produce optimum quality and quantity livestock growth gain response on the specific range conditions as inventoried by the Agrostological Study. This formula is believed to be the most appropriate to meet the conditions described. Experience gained thru actual implementation may suggest a need for longer or shorter periods of deferment as actual dates of "peak of flowing" time and "seed maturity" time for the several desirable grass species are further documented. In any case the grazing formula applied, is charged with a mandate to maintain good forage grasses where they occur now, as well as to restore upward trends on poor and fair condition ranges. The grazing treatment schedules are thus prescribed to improve ecosystem health and thus better forage and livestock production thru both the short and long term.

D. Grazing Block pasture patterns and grazing treatment

The Grazing Formula and Beginning Stocking Guidelines are provided in this plan for each Grazing Block. The Graphic section (overlays n°5 and n°1) showing the scheduled sequence for each specific Grazing Block, is filed in a separate Graphic section binder for each Grazing Block.

E. Sequence of grazing treatment scheduled during the "wet" or "rainy" season pastures (in the village plans and in the Grazing Block Plan) and the reason for each.

The sequences for twelve consecutive years is as follows (the treatment order of the pasture to be grazed may be adjusted by the Manager and Association to closely match the rainfall in pastures and adjusted back to the regular schedule the following year)

1st year	start grazing in early wet season for livestock production.
2nd year	start grazing in early wet season for livestock production.
3rd year	pasture deferred to about August 20th (peak of flowering) for "half-vigor" recovery on key desirable forage grasses; livestock "walk-in seeding" of key desirable species on late used part of pasture plus livestock production.

4th year	Rest yearlong for vegetative litter accumulation to mulch soil, for "full-vigor" recovery of adult desirable grass plants, plus protection of seedlings.
5th year	Grazing starting in early wet season for livestock production.
6th year	Grazing starting in early wet season for livestock production.
7th year	Deferment to "peak of flowering" (about August 20th) for "half-vigor" recovery, on key desirable forage grasses, livestock "walk-in seeding" on late used part of pasture plus livestock production.
8th year	Deferment to "peak of flowering" (about August 20th) for "full-vigor" recovery on key desirable forage grasses plus benefits same as 7th year treatment.
9th year	Rest yearlong for vegetative litter accumulation for soil mulching, and for seedling establishment of desirable species.
10th year	Grazing starting in early wet season for livestock production.
11th year	Deferment to peak of flowering (about August 20th) for "half-vigor" recovery on key desirable forage grasses, for livestock "walk-in seeding" on late used parts of pastures, plus livestock production.
12th year	Deferment to peak of flowering (about August 20th) for "full-vigor" recovery plus other benefits of 11th year treatment.

At the end of the 12th year repeat the grazing treatment sequence, start with year 1, then continue thru year 12 except as may be modified from current monitoring and evaluations.

F. Sequence of grazing on "dry" season pastures.

Five out of six dry season pastures are to be grazed annually starting after about September 25th (seed ripe time) for livestock production, plus providing favorable situation for vigor and density recovery for key desirable forage grasses. The treatment will also optimize livestock "walk in seeding" benefits.

One dry season pasture of six is scheduled for yearlong rest each year in order that each dry season pasture can be provided year long rest once every six years.

This treatment is to speed up restorations of key desirable grasses and shrubs thru permitting an accumulation of vegetation litter and mulching for moisture holding and fertility benefits on presently compacted and/or litter poor soils.

The "dry" season pastures designated for rest in any one year (one in each of the 9 Grazing Blocks), provides an additional very essential reserve of forage for emergency use, in the event it must be used periodically.

G. Grazing System Shake-down Periods

Most large Grazing Systems and especially those designed for low-rainfall areas require a shake-down period for at least five years beyond the time the system is fully implemented.

Range Management expertise must be provided each Grazing Block at least thru this period that has the responsibility and author ty to make correct sweeping changes if necessary to strengthen the system as results of implementation and grazing impacts are monitored in each pasture. Items that may call for this continuing top Range Management capability may include consolidating Grazing Blocks and the pastures within them or further evaluating and adjusting stocking.

H. Monitoring the Grazing System and controls

A sample "Grazing Block Inspection Check List" is attached which lists key items to be inspected and followed up on in each pasture of each Grazing Block annually. This current monitoring and follow up will be mandatory if adequate control is to be maintained and obviously calls for trained and experienced Blocks Managers operating as part of the staff of the Range Management Organization.

I. Photo Grid Plot Transects for Documentation

Range condition and trend measurements must be documented by the most simple and understandable tool available. The Photo-Grid Plot Transect provides an effective means of meeting this need and is recommended.

These control transects are proposed to be established at each of the 100 fenced control plots proposed for a like number of pitting or deep furrow Drill and seeding tracts described under "Revegetation Project." Similar control transects are proposed within 1 km distance of the highest producing well in two wet season and two dry season pastures in each Grazing Block.

Rereading on these transects is proposed at least at 5 year intervals. The Grazing Block Manager should by all means participate in establishing and rereading these transects so that the monitoring process and

current evaluation routine to be an integral part of the Grazing Block Manager authority and responsibility.

The transect control document, the long term results of day to day field observation follow-up supervision, training and solutions that make up the Grazing Block Managers responsibility.

J. Fenced control Plots

Details pertaining to the design and location of these is covered in the Revegetation Project Section. Positively controlled fenced Plots can provide a very accurate documentation of range response and production that can be accomplished where and when the Grazing System is carried out as prescribed. These Plots should form a very integral part of the Grazing Block managers current monitoring and evaluation responsibility. These Plots can only perform their proper function if the gates in the control Plot fence are opened when the surrounding pasture is authorized for use and closed when pastures are to be deferred or scheduled for yearlong rest.

VIII. Range Development

A. Structural:

1. Measurement Marks - The purpose, design and location has been discussed under "Methods". Costs of construction are based on operating experience with a motor grader construction unit similar to that proposed, operating on soil and vegetative types. Hand labor clearing and painting may cost less in certain situations but the cost applied includes location costs which may increase through complexities in location agreement in densely cultivated communities. Itemized approximate costs of the construction unit are provided. The management marks will need to be maintained at three to five year intervals.

2. Access ways: These are to provide access for both the well-digging and maintenance and for subsequent regular inspections and management of the grazing system at the water points by both the Grazing Block manager and the designated water custodians of each pasture. For the immediate future these "ways" would need to be traversed by the well-drilling and maintenance unit and subsequently traveled annually by 4-wheel drive vehicle or motorcycle. These will also need to be maintained at 3-5 year intervals.

3. Water development: Considerable water is already available in existing wells and from running and intermittent rivers as well as Lake Chad in dry season.

There is a need for a substantial number of additional wells to provide balanced water supply distribution in each of the planned management units. Water must be available in each pasture so that water and the key rangelands near water points in deferred or rested pastures will not be used by livestock except during the periods these pastures are scheduled for grazing.

The criteria for determining water need for the Grazing System with the above disciplines were as follows:

1. 20 liters per UBT unit per day requirement.
2. Cement well yield is based on animal traction at 20 liters per minute for 12 hours.
3. Artesian well average yield was estimated at 5000 liters per hour.
4. Approximately 5 km maximum travel distance to water.

Summary sheets showing existing water volume and additional needs by Grazing Blocks, by pastures, is attached. Location and number is shown on overlay #2 in the Graphic Section.

Wells proposed for construction vary in number with a choice of one of three options all of which pertain to Grazing Block D only. These options and the number and kind of wells called for in each option are as follows:

(1) Total Assale-Serbeouel Project area calls for construction of 149 cement wells, 58 of which are proposed in regular Block D which extends South of the Chad-Nigeria road into the Yacres zone in part, to an extreme south latitude at one point north of Ngama to about latitude 11°43'.

(2) Total project Area same as option 1 extending south across Chad-Nigeria road to about latitude 11°43' but constructing a total of 93 cement wells in dry season pastures only project wide, plus 11 artesian wells all of which would be located south of the Chad-Nigeria road in Block D and with only 2 additional cement wells in that Block D.

(3) Total project area and specifically Block D (Alternate) limited to area North of Chad-Nigeria road. Total project area calls for 96 cement wells in dry season pastures only.

An additional number of wells are indicated to be needed for the limited dry season grazing which will be available in pastures designated as wet season pasture. These wells can provide additional livestock water needs necessary to more efficiently utilize cropland after harvest time. This total need is shown as 117 wells but it is known that much of this indicated deficit of well water supply is provided by rainfall in the wet season. A firm estimate of the amount and location of livestock water needed for harvesting the matured cultivated crops (by grazing) which are grown in these pastures mostly otherwise grazed in the wet season, can probably not be known until the village agriculture and Grazing System planning is completed. The construction of these wells is therefore deferred to a second phase when a more firm estimate of need will be available.

PROPOSED WELLS SERBEOUEL Sector

BLOCK	CEMENT WELLS				ARTESIAN WELLS				GRAND TOTAL
	DRY SEASON				DRY SEASON				
	No.	Unit Cost	Total Cost		No.	Unit Cost	Total Cost		
A	6	$8000	48,000						
B	2	"	16,000						
C	10	"	80,000						
D	30	"	240,000						
or D option 1	30		240,000		11	50,000	550,000		
Total option 1	48		384,000*						1,132,000
Total option 2	42		336,000*		11		550,000		1,024,000
D-alternative	23		184,000*						
Total option 3	41		328,000*						878,000

* Proposed as second phase operation subject to substantial reduction following on-site surveys to be made in village agriculture farm and grazing system planning and/or needs determed by initial implementation.

+ This total is to be reduced to dry season pasture water developments in first phase operation as qualified in the above footnote.

Continued on next page --

PROPOSED WELLS SERBEOUEL Sector

BLOCK	CEMENT WELLS			ARTESIAN WELLS			CEMENT WELLS			GRAND TOTAL
	DRY SEASON			DRY SEASON			WET SEASON *			
	No.	Unit Cost	Total Cost	No.	Unit Cost	Total Cost	No.	Unit Cost	Total Cost	
A	8	$8000	64,000				6	$8000	48,000	
B	3	"	24,000				2	"	16,000	
C	8	"	64,000				10	"	80,000	
D	58	"	464,000				30	"	240,000	
or D option	2		16,000	11	$50,000	550,000	30		240,000	
TOTAL	77		616,000				48		384,000*	1,000,000+
TOTAL w/ D option			168,000	11		550,000	48		384,000*	1,102,000+
D-Alternative	5	"	40,000				23		184,000*	
TOTAL w/ D-alternative	24		192,000				41		328,000*	520,000+

* Proposed as second phase operation subject to substantial reduction following on-site surveys to be made in village farm and grazing system planning and/or needs determed by initial implementation.

\+ This total is to be reduced to dry season pasture water developments in first phase operation as qualified in the above footnote.

Continued on next page --

PROPOSED WELLS ACSAIE Sector

BLOCK	CEMENT WELLS Dry Season No.	Unit Cost	TOTAL Cost	CEMENT WELLS Wet Season No.	Unit Cost	TOTAL Cost
E	29	$12,000	$348,000	-	---	---
F	9	"	108,000	15	$12,000	$180,000
G	14	"	168,000	21	"	252,000
H	11	"	132,000	16	"	192,000
I	9	"	108,000	17	"	204,000
TOTAL:	72		$864,000	69		$828,000

*$1,692,000 ***

**Proposed as second phase operation subject to substantial Reduction Following On-site Surveys to be made in Village Farm and Grazing system planning and/or actual needs determined by initial implementation.

***This total is to be reduced to dry season pasture water development in First phase of operation as qualified in the above footnote.

B. Non-Structural Development

1. Revegetation Project for Arsale-Serbeouel Grazing Unit.

a. Pitting or deep furrow drilling and seeding of key perennial grasses is proposed in pilot tracts on better quality rangeland soils where vegetation, range site microclimate and thus production is badly deteriorated to mostly Annual grasses and spotty vegetative cover. Seeding areas are to be cleared of large tree growth to conserve available moisture and located within two km of water points existing or proposed.

The propose of the seeding in addition to contributing to increasing and stabilizing livestock production for the site is to provide pilot experience in establishing and managing revegetative areas on these and similar ecosystems. The seeded tracts will also serve as bench marks for monitoring range management performance and range response in the Grazing System.

These seeded tracts will provide certain evaluation controls and demonstrate that:

(1) Desirable high producing native perennial grasses can thrive in the local nursery and then on the project pastures by carrying out the Grazing System.

(2) That the Grazing System implemented is allowing certain native perennial grass species to thrive and maintain high production although grazed in proper season and stocking 5 years of six.

(3) That if extention and organizational effort can induce the communities to herd there livestock in accord with the Grazing Plan so that the seeded perennials will be maintained, then the variety of desirable perennial species indigenous to the rangeland would very likely be restored and maintained.

(4) Conversely, if sufficient herding and numbers control effort is not forthcoming on the Grazing Block initially implemented and seeded, to maintain these native seeded perennials - then the odds of reaching the objective likely would be Nil on the Sahel-Sudan rangelands at that point in time. In that case more effective extension and organization at all levels would need to proceed further range development or implementation until the odds for adequate management capability were favorable.

. Cost estimates:

Pitting and seeding or deep furrow drilling:

2000 hectares in approximately
100 pastures at 100.00 = $200,000.00
(to be programmed at rate of approximately 200 hectares annualy in 10 or 20 hectare tracts in 10 additional pastures starting the first year after a Grazing Block is implemented).

(For equipment and housing see detail cost summary)

b. Fence construction will be required on control plots on each seeding tract. Each control plot will consist of two adjoining 1/4 hectare fenced tracts (50 m x 50 m) on the edge of each seeded tract. Each tract will include equal area of seeded and untreated rangeland. Across-fence at midpoint within a 50 mm x 100 mm total tract will protect 1/4 hectare for total enclosure of livestock with no gates. The remaining 1/4 hectare tract will be provided gates on each side, to be opened and/or closed to coincide with the grazing treatments scheduled for that pasture. The latter 1/4 hectare tract will be made available for livestock grazing only when that Grazing Block is authorized for grazing and within Beginning Guideline Stocking.

Cost estimates:

Fencing 100 control plots on 100 tracts 1/3 km at 2500.00	= $ 830 ea = $ 83,000.00
Opening and closing gates and maintainance of tract fences 5grds at 200.00 ea on 100 tracts	= $ 20,000.00
1 Truck	= 10,000.00
1 Land Rover	= 5,000.00
	$118,000.00

c. Establishing and maintaining photo grid plots for documenting rangeland performance and range response on seeding projects:

2 transects of 4 ea photo grid plots (see attached design) to be established at edge of each seeding tract:

1 transect in the 1/4 hectare "total enclosure" . (2 plots in seeded and 2 plots in unseeded range site.)

1 transect in the 1/4 hectare plot with two gates: the latter plot to be made available for grazing only in the Grazing System. (2 plots in the seeded and 2 plots in the unseeded range site).

Establishing and reading 2 transects on 100 ea tract at at 250.00 = $50,000.00

Rereading plots at end of 5 year period _____ = 55,000.00

d. 1 nursery operation for 5 years: Pitting and seeding trials on approximately 20 hectares of rangeland representing principal vegetative types and soils to be seeded.

The trials would be principally directed to application of a pitting disc and deep furrow drill equipment for seeding several leading mostly native perennial forage grass species known to be the potential dominant key species in principal soil types in the 400-500 mm rainfall zone.

No irrigation, little or no fertilizer support and no ploughing and seeding would be included the first phase of these trials.

Project Manager counterpart and staff(5 yrs)	375,000
Special equipment tools and sic	12,000
Fence 20 ha (1.3 km at 2,500 = 4,500)	4,500
2 caravans	20,000
1 Land Rover	5,000
1 storage and warehouse and quarters	60,000
1 truck	10,000
	$486,500

e. Total cost revegetation project summary:

Nursery (rounded) = 486,500	486,500	
Pitting or deep furrow drill + seeding	200,000	}
Fencing control tracts	118,000	} Re-vege-
Custodian of seeding tracts and control plots	20,000	} tation project in addition to nursery.
Establishing photo grid control transects	50,000	}
Rereading at 5 years	55,000	}

Total revegetation project cost = $[illegible]7,000

2. Establishing and reading photo-grid condition and trend documentary plots on key primary watersheds.

Establish 1 transect of 4 ea. photo grid-plots (see design attached) on average condition range site within 1/2 km of highest producing water point (or village edge in which it is located) in two wet season and two dry season pastures in each Grazing Block. This documentation is a necessary part of the management monitoring job.

4 ea. on 9 Grazing Blocks = 36 ea. at 250.00 =	9,000.00
Rereading these plots at end of 5th =	10,000.00
TOTAL	$18,000.00

Project Cost detail

(Background itemization in addition to that shown on "Planned Range Improvements - Costs Summary")

Contract Seminars

40 ea seminars - TOP QUALITY ON "LANGUAGE OF THE RANGE-LAND"
such as presented by Dr. A.L. Hormay
4 ea (1-wk duration) PER YEAR FOR 10 YRS.
@ 10,000 = 400,000

Participant Training

10 students from Cattle Culture Heritage in low rainfall areas for eventual block managers and range management division.

ea 4 YEAR's UNIVERSITY ABROAD @ 10,000
1 YEAR AGENCY PARTICIPATION ABROAD @ 10,000

TOTAL = 500,000

Overhead Personnel

1	Range Adviser-Highly experienced in application of similar grazing systems in semi-arid range 10 years - @ 60,000	600,000
1	counterpart 10 years @ 20,000	200,000
2	sector chiefs " " @ 100,000	1,000,000
9	block managers 5 yrs @ 90,000	450,000
4	drivers and mechanics @ 8,000 (10yrs)	80,000
50	water custodians 5 yrs @50,000	250,000
		2,580,000
4	pickup trucks jeep gladiator or landrover @ 5,000.-	20,000
8	motor cycles for block managers @ 1,000	8,000
50	bicycles @ 80	4,000
9	block manager residences @ 20,000	180,000
		212,000

Overhead continued

For village agriculture and Grazing System planning - 600 villages @ 35 ea. per M.YR.

4 men 2 ea-2 man teams @ 50,000 per M.YR.	840,000
4 pickup trucks	20,000
4 caravans	40,000
	900,000
TOTAL OVERHEAD COST	3.692,000

Summary

Seminars	400,000	
Training	500,000	
*Overhead	3,692,000	
	4,592,000	4,592,000
(Range Improvem.	3,217,850)	(3,217,850)
	(7,809,850)	(7,809,850)

MAINTENANCE COSTS

Management and Firelines and access ways

2 rounds @ 100,000	200,000
Equipment Maint.+other	30,000
Plant Maint. (Makari, Karal, Nursery and wells	120,000
TOTAL MAINTENANCE	350,000

Total cost in addition to range improvements = 4,942,000**

*overhead cost for Nursery included in those costs.

** $15,000.oo per year per sector for Fire Control for 10 yrs ($300,000.oo) is not included in the above totals.

OPERATING COST - ANNUAL

MAINTENANCE	35,000
OVERHEAD	160,000
TOTAL OPERATING COST - ANNUAL	195,000

(after 1 Range Advisor and 2 Sector Chief assignments have been completed)

C. Maintenance of Improvements:

This is to insure that all range development structures will be maintained in good working condition through a full five year period after the Grazing System is fully implemented. This maintenance is very necessary and critical to the success of the operation. It is mandatory if full committment through successful participation is to be gained.

Maintenance costs are based on the assumption that approximately 1/5 of the structural developments would be maintained annually.

It is expected that light maintenance of wells and troughs would be accomplished by water custodians and that they would provide information for need of heavier preventative maintenance needs.

D. Correlation with other uses

The Grazing Treatments prescribed are expected to increase forage plant vigor and de sity and soil mulch. This will improve the general health of the range and tend to improve the habitat for livestock, for people and for wildlife. The increased density of water points may tend to increase the area of yearlong habitat for some small wildlife.

The use and value of wildlife will probably tend to become more emphasized and more associated with livestock production rather than less in the future.

It is improbable that use of forage by wildlife will be a significant competative factor in the grazing unit if the Grazing system is capably carried out.

LIST OF SOME OF THE PEOPLE MET IN
CHAD AND CAMEROON
IN ASSALE-SERBEOUEL PROJECT ACTIVITIES
AND ADJACENT AREAS

Dr. Benson Tonwe - Executive Secretary, LCBC
Dr. Ngaba - Chief of Livestock Division, LCBC
Dr. D. C. Crouail - UNDP/FAO Project Director, LCBC
Dr. A. Gaston - Ecologist, Farcha Laboratory
Dr. Vallet - Assale Sector Chief
Mr. Pashe - Assist. Assale Sector Chief
Scotty D. and Mrs. Deffendol & Family - Serbeouel Sector Chi
Dr. G. and Mrs. Garrousse - Director Cameroon Livest.Divisio
John Lundgren - Director US/AID Chad Mission
Jack Nixon - Program Officer US/AID Chad Mission
Van and Mrs. Henderson - Project Manager
Val and Mrs. Mahan - Assist. Program Officer
Jeannette Isaacs, Gertrude, Inge, and staff
Rick Carron - Contractor: Project Technician
John Koehring - RDC [illegible]
Lawrence Berry - AID Contractor
Fred Webber - Contractor
Davie Davis - World Bank Team
Irving Licht - Evaluation Officer, AFR/W
George Mc.Leroy - Livestock Advisor
M. J. Morgan - Agricult. Engineering Advisor
E. D. Eddy - Economist
W. Fagan - Project Officer
L. W. Bond - Project Design Officer
Bernard LeTourneau - Caterpillar Engineer
Chad Rural Project Fund Appraisal Mission (World Bank):
Klaus Meyn - Livestock Specialist
Eugene Sinodinos - Livestock Specialist
David Steeds - Economist
Isik Erim - Economist

Continued LIST OF PEOPLE MET

Tom Bright - Irrigation Engineer, Consultant
John Howell - Forester, Consultant
Te-Sun Hoa - Agronomist, Consultant

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   Dr. S. P. Reyna, Project Assale-Serbeouel, Lac Chad Basin Commission
   N'Djamena, June 15, 1974

2. "Agrostological Study of Pasturelands, Assale-Serbeouel Project", Republic of Chad and United Republic of Cameroon
   Carried out by A. Gaston, Doctor of Ecology and Pastoralist, with collaboration of G. Lamarque (Cartograph Engineer), J. P. Lebrun (Afr. Agr. Engineer), and R. Riviere (Dr. of Vet. Med. IEMVT) under direction of M. Thome, Director General IEMVT, and A. Provost, Director General African Research Region and G. Boudet, Director of Research, IEMVT. Institute of Stock Raising and Vet. Med. in Tropical Countries (IEMVT), 10 Rue Pierre Curie, 94700 Maisons Alfort, France;
   Commission of Lake Chad Basin - English translation, Washington DC.

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   Institute d'Elevage et de Medecine Veterinaire des Pays Tropicaux, 10 Rue Pierre Curie, 94700 Maisons Alfort, France; Lake Chad Basin Commission, BP. 727, N'Djamena, Republic of Chad.

4. "Resource Inventory of North Cameroon" (exclusive of Adam Aoua Division),
   Prepared by joint USAID, FAC Team:
   Donald H. Fulton, Range Conservationist SCS,USDA
   Jean Boulet, Geographer, ORSTOM
   James E. Bauer, Soil Scientist, SCS, USDA
   Guy Escoffier, Agronomist, SOLET International
   Paul D. Landry, Soil Conservationist, SCS, USDA
   Dr. George B. McLeroy, Livestock Specialist Consultant
   Prepared under PIO/T #625-11-995-907 Development Studies of the Sahel-Sudane Zone for US/AID, Feb 1976
   USDA, SCS, Wash.DC.

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