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Sudan

Community Based Rangeland Rehabilitation for Carbon Sequestration and Biodiversity

SUD/93/G31

Report of the Terminal Evaluation

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I. List of Abbreviations

CAHW	Community animal health worker
CBRRP	Community Based Rangeland Rehabilitation Project
CDM	Clean development mechanism
EIS	Institute of Environmental Studies of the University of Khartoum
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIS	Geographic information system
GOS	Government of Sudan
GPS	global positioning system
ha	hectare
km	kilometer
m	meters
M&E	Monitoring and evaluation
NEX-MSU	National Execution Management Support Unit
PD	Project document
PIR	Project Implementation Review
PPER	Project Performance Evaluation Report
PVC	polyvinyl chloride
RC	Rural council
RPA	Range and Pasture Administration
SSA	Swedish Sudanese Association
tC	metric tons of carbon
TPR	Tripartite review
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
VDC	Village Development Committee
WFP	World Food Programme

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A. Introduction

1. The Community Based Rangeland Rehabiltation Project (CBRRP) is situated within Gireigikh rural council of Bara Province of North Kordofan State. The CBRRP is a carbon sequestration pilot project, the first of its kind in Sudan. The project was approved prior to the GEF 1995 Operational Programmes being formulated and prior to incremental cost considerations for climate change projects coming into force. The project was prepared during the GEF Pilot Phase.

2. The project's main development objective was twofold: a) to sequester carbon through the implementation of a sustainable, local-level natural resources management system that that prevents degradation, rehabilitates or improves rangelands; and b) to reduce the risks of production failure in a drought-prone area by providing alternatives for sustainable production, so that out-migration will decrease and the population will stabilize. These development objectives follow the Fourth UNDP Country Programme's (1993-1996) three areas of concentration: (i) sustainable rural development, (ii) promotion of food security, and (iii) strengthening of national capacity to manage development. The key stakeholders of the project were the community of the Gereigikh Rural Council, the Range and Pasture Administration office of North Kordofan State and the Federal Range and Pasture Administration.

3. The terminal evaluation was performed by a mission that consisted of five members: a representative of the project staff, a local rural development specialist, a local rangelands management specialist, a monitoring and evaluation officer from NEX-MSU, and an international consultant who served as the team leader. The mission took place between 24 April and 7 May, 2001. The mission made field visits to numerous villages within the Gireigikh Rural Council, including participating Village Development Committees and community user groups. Additionally, the mission conferred with government officials, project personnel, and UNDP Country Office personnel in Khartoum.

B. Conclusions

4. **A Successful Model for Carbon Sequestration.** The most pressing conclusion emerging from this evaluation is that the project strategy to rehabilitate and improve marginal lands has demonstrated the potential to enhance carbon sequestration. This has been evident as a result of the project's successful combination of a) participatory planning, b) introduction of relevant innovations and strategies, c) capacity building, and c) access to credit for productive activities.

a) **High Impact.** Ultimately, the proof of the impact of such a project is that its outcomes are of sufficient appeal to the range of stakeholders to offer good potential to be a model/catalyst for other areas. Within the project area, several major objectives exceeded original targets project due to perceived benefits. Outside the project area, there is evidence of positive leakage as several villages that have not been involved in the project have, by virtue of accepting the premises of the intervention through contact with project villagers, begun to implement some of the project strategies.

b) **Strong Performance in the Last Half of the Project.** The project has performed very well at most levels over its final three years. Despite a bad early start to the project, a period in which

certain project objectives were misinterpreted and project milestones were not kept, the project rebounded well enough to achieve the core activities. A dedicated and creative project staff, led by an effective national project director, combined to create a positive working environment. Together with an evident keen interest on the part of the UNDP Country Office, the project was a strong and effective performer in its latter stages.

c) **Continued Relevance.** In the view of the evaluation team, the project villages are well equipped with the knowledge, innovations (e.g., seeds), and trained personnel for continued activity to promote the development objectives of the project. The quality of trained local committee members is quite adequate and they are capable of sustaining project activities into the future. The fact that many project activities were active at the time of the evaluation mission, and were being administered by local villagers in the absence of the project staff, is a good indication of the relevance and sustainability of the overall effort.

C. Recommendations

8. **Recommendation 1: Carbon Monitoring.** Carbon-monitoring activities should be extended at the project site for a reasonable period of time, say for another three to five years. A carbon monitoring protocol that includes soil organic carbon should be established and carefully vetted with international experts. Such a program should be linked to the collection of a range of other relevant data on rainfall, temperature, and socioeconomic conditions in order to establish the effect of a range of pertinent factors on carbon storage rates.

9. **Recommendation 2: Codification of Successful Project Activities.** Certain activities were more effective than anticipated, especially the setting aside of private cultivated lands for pastoral grazing, organization of villages into development committees and subcommittees, and the introduction of improved cookstoves. Efforts should be made to incorporate the approaches used in the implementation protocols for other projects.

10. **Recommendation 3: Follow-up Project**. A follow-up project that extends the participatory model developed at Gireigikh to a much larger scale, say in at least 1,000 additional contiguous Rural Councils in Kordofan State, would be highly desirable. Outputs of such a project would help to validate that the model is workable at the larger scale needed to attract international climate project investments.

11. **Recommendation 4: Re-introduction of cattle into the region.** A study should be commissioned that examines the costs and benefits of a gradual reintroduction of cattle to the region. Such a strategy could obviate the monocultural species tendency in fields that have been converted to pastoral lands.

12. **Recommendation 5: Facilities at the Project Site.** The equipment and facilities should be kept intact until final resolution of possible follow-up activities at the project site and surrounding regions. Steps should be taken to ensure a more active government involvement and support to local-level planning in the future.

D. Lessons Learned

13. The whole of the Giraigkh initiative is an investment in people through technical and institutional assistance, loans and policy support. Within this framework, the various project

elements were instruments for simultaneously enhancing carbon sequestration while closing the gap of finance in the rural economy by providing investment resources to the communities.

14. The key lesson that has emerged from this plot effort is the role of public ownership as a major factor of success. Not the project staff, government agencies, or the Agricultural Bank of Sudan had (or has) any direct management responsibility over the resources provided to the Gireigikh RC. Yet, it was evident that a high degree autonomous self-monitoring was taking place. For this reason, any future effort to sequester carbon in semi-arid areas of Sudan should carefully consider applying the broad principles embedded in the project design, suitably adapted to reflect other local contexts. As a corollary, another lesson is the importance of encouraging the engagement of private assets. This was a notable though unanticipated direction of the project as private grazing allotments became a locally driven development.

V. Project Concept and Design

A. Context of the Project

15. At the time the project was conceived, government policy was highly focused on irrigated and mechanized rain fed cultivation. Little provision had been made in either the 1992-2000 Comprehensive National Strategy, or in regional government policy and plans to develop and support smallholder production systems. At the same time, the project document notes that it was clear that the Government of Sudan (GOS) was concerned about people in drought-affected areas. The contribution of smallholder production systems were considered to be an important for maintaining local employment and in contributing to national economic output, and various plans had been put in place for food security. Yet, apart from government approval of some multilateral pastoral development projects, there was no national coordinated strategy to rehabilitate and preserve smallholder agro ecosystems.

16. It is also fair to say that at the time the project was conceived there was little awareness in government about the issue of climate change and about Sudan's role in taking steps to combat it within in the context of its international commitments. Nevertheless, Sudan was a signatory to the UNFCCC and was poised to receive funding for enabling activities to build capacity in how to assess both sources and sinks for greenhouse gas emissions. Given its vast land resources and varied ecosystems, carbon sequestration potential was a highly relevant topic.

17. The project concept was conceived within these two areas of need – the lack of coordinated strategies for pastoral development and the potential for sequestering carbon in these lands that can be a response to the threat of climate change. The project concept, in simultaneously addressing these two issues, was entirely appropriate at the time it was conceived.

18. Several elements related to the government's macroeconomic policy framework were marginally referred to in the project document, which noted the importance of agricultural production to national GDP, exchange rate disincentives, implicit subsidies to large mechanized farms, and the changing face of rural labor brought on by urban migration. The Project Document mentioned that the "… government of Sudan is faced with low revenue coupled with increasing government expenditures, and a resulting fiscal gap." As a percentage of total government spending, the share of agriculture had been steadily dropping over the ten years previous to the project.

19. The project fit nicely with regional projects that were being implemented at the time. The project document outlines several projects of interest that are complementary to the objectives of the project. Notably among these was the Kordofan Area Development Scheme which had as its mandate to foster economic development through a participatory planning framework. The CBRR project design, by its commitment to the notion of investing in existing community networks, was highly complementary to this and the other initiatives.

20. One of the attractive features of the project's design was its aim to address several key areas of concentration in parallel, namely poverty alleviation, natural resource management, technology transfer, and women in development. An interested observer might be tempted to pose the question: are these outcomes co-benefits of an effort to sequester carbon, or the other way around? Either way, under emerging carbon crediting frameworks, the key issues will likely be the attractiveness of the investment.

21. The mission believes that the problems facing agro ecosystems were clearly identified by the parties and that the action taken in 1993 was appropriate. The implementation of this project was timely and the institutional networks were well placed within the overall village organizational structure.

B. Project Document

22. The major environmental issue addressed by the project was land degradation, the major causes of which were considered to be recurring droughts, cultivation on marginal lands, and firewood gathering. The Project Document indicates that the aim of the project was to test an approach to help grassroots communities in the Gireigkh Rural Council create a land use management system that better utilizes natural resources on marginal lands. If effective, such efforts would lead to enhanced carbon sequestration and biodiversity. As the PD states, "…community participation in rangeland management, coupled with secure land tenure and a favorable socio-economic political situation, will lead to improved and sustainable range management and livestock production with the need for fencing, in an environment used by a settled agro-pastoral community and a satellite, mobile, purely pastoral community." At the time the PD was written, GEF support was considered appropriate on several grounds as follows:

a) addresses desertification/deforestation elements,

b) demonstrates viable methods for a community-based approach to climate change through carbon sequestration,

c) creates synergies between efforts to address global climate change concerns and local poverty alleviation,

d) holds replication potential to other semi-arid regions in Sudan where similar patterns of overexploitation of marginal lands exist, if the approach is found to be successful in Gireigikh,

e) promotes participation, helps people to help themselves, and provides needed rural development resources

1. The Problem and the Technical Approach

a) The project was designed as a pilot project in the Bara Province of North Kordofan State to test a specific model for a community-based natural resource management system. The problem that the project attempted to address is the overexploitation of marginal lands for agriculture in a region that has proved historically prone to drought. The goal of the project was to demonstrate at the local level that an appropriate community-based natural resource management system could be implemented that would reverse prevailing land degradation trends, and effectively sequester carbon. The villages in the Gireigikh Rural Council were chosen because they represented a good example of a pattern of grassland conversion to cropland, leading to serious land degradation, and resulting in the loss of carbon sinks.

b) The technical approach to intervention was based on two fundamental assumptions. First, the project considered that a community-based participation was an essential approach to improving rangeland management. This meant devising an implementation strategy relied on existing, traditional mechanisms of leadership, social discipline, alliances and reciprocity between tribes that use the same land resources. All project activities were focused at the village or village council level for the Gawamaa tribe (agropastoralists) and the satellite camp level for the Kawahla tribe (transhumants).

c) Second, the project considered that some activities, not directly related to carbon sequestration, would be needed to create a favorable context for project interventions. For this reason, certain measures intended to address socio-economic conditions were included in the project design in order to meet the community's short-term survival and production needs. Among others, these activities focused on fodder production, water development, livestock restocking, development of village-level irrigated gardens, introduction of revolving credit systems, and drought contingency planning. The driving premise for such activities was that achieving a long-term improvement in natural resource management and land rehabilitation could only be accomplished if accompanied by development activities that met villager near term needs.

d) In its concept design, the project offers a model for meeting multiple objectives in light of the challenge of climate change. The implementation of the project's natural resource management strategies were intended to simultaneously lead to carbon sequestration in soil, improvements in soil quality by raising productivity and contributing to sustainable land use, and enhancement of overall environmental quality through improved biodiversity and erosion reduction. The evaluation team considers that the concept design of the intervention is sufficiently well-formed as to yield important insights into whether sequestering carbon is compatible with other goals important to communities living in semi-arid areas. While no specific alternatives were considered in the project design, the evaluation team does not consider this a deficiency in light of the project's status as a pilot effort.

e) The project strategy is compelling in many ways. The current increase in atmospheric carbon is the result of anthropogenic mining and burning of fossil carbon, resulting in carbon emissions into the atmosphere that are not in balance with natural or anthropogenic sequestration. The development of sustainable models and approaches in areas where land use patterns are leading to the loss of carbon sinks can contribute to an understanding of the link between rangeland management, carbon storage, socioeconomic improvement, while diminish the net positive atmospheric flux.

2. Objectives, Indicators and Major Assumptions

a) The project was conceived to be a pilot effort to test a model of community-focused intervention with the aim for replication to other semi-arid areas if proven successful. The project had two overall development objectives. The first objective was to create a locally sustainable natural resource management system that would both prevent overexploitation of marginal lands and rehabilitate rangelands for the purpose of carbon sequestration, preservation of biodiversity, and reduction of atmospheric dust. The second objective was to reduce the risk of production failure by increasing the number of alternatives for sustainable production strategies, thereby leading to greater stability for the local population. These development objectives are clear and well-formed, albeit somewhat overlapping.

b) While these development objectives fall beyond the emphases on Sudan's Comprehensive National Strategy (1992-2000), which had little provision for encouraging and developing smallholder production systems, they nevertheless are consistent with the government's stated commitment to environmental conservation, sustainable production, and assistance to drought-affected areas.

c) The development objectives were addressed through the implementation of four immediate objectives as follows:

a) An enhanced capability by local communities to manage their natural resources in a sustainable way,

b) An enhanced ecological capacity for rangeland regeneration the introduction of community-based interventions,

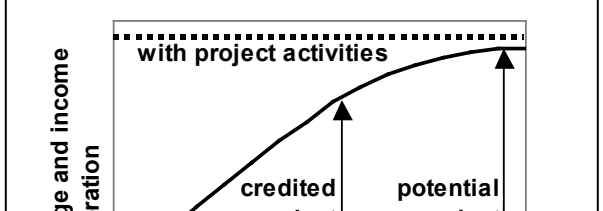
c) A diversification of the local production system through improvements of basic outputs and the introduction of appropriate technologies, and

d) Drought contingency measures to mitigate the adverse effects of drought and improve socio-economic conditions.

d) The project document does not provide success indicators for any of the immediate objectives shown above, representing a problem that confronts an effective evaluation. However, it is the understanding of the evaluation team that at the time the project document was prepared, success indicators were not explicitly required for immediate objectives, as they are at present. For this reason, the "expected end of project situation" with its focus on both environmental benefits and development benefits has been taken as a proxy for an explicit indication of success. End of project situations have been explicitly identified for carbon sequestration, biodiversity improvements, atmospheric particulate reduction, and development benefits. These represent a reasonable approximation of success indicators for the project.

e) The intended impacts of the project's immediate objectives were to increase both carbon storage and household income, as shown in Figure 1. When defining the end of project situation regarding carbon storage, an implicit though unstated assumption in the project document was that no further land degradation would take place in the project area over the next 20 years. That is, incremental carbon sequestration benefits were measured against a static baseline. In fact, land degradation is expected to continue in the absence of project activities. The assumption of a static baseline has the effect of underestimating potentia

Figure 1: Project benefits and the end of project situation



establishing a defensible baseline, and thus address important additionality concerns, was not addressed in the project document, or in subsequent project activities.

f) The estimates of carbon sequestration levels in the project document contain another difficulty that may overwhelm this effect. The total area of communal rangelands for the 5 Village Councils participating in the project was estimated to be 60,000 ha in the project document. However, the **total** land area controlled by the Village Councils is only about 24,000 ha. Of this amount, only 2,532 ha have been classified as communal rangelands. Since the management of rangelands was the largest component of expected future carbon sequestered (about 95% of total projected) this downward correction has a large effect on the end of project carbon sequestration benefits.

g) From a carbon accounting perspective, the document mixes both near-term (i.e., within the life of the project itself which lasted from May 1995 to December 2000, or 5½ years) and long-term (i.e., over a 20-year period) project benefits. Only those actual benefits achieved by the end of the project can be verified, because they are the only benefits directly measurable by the resources provided by the project. The end of project situation is further defined in the project document as yielding "direct" carbon sequestration benefits, (i.e., due to project activities, and expected to occur either during the project lifetime, or within a 20-year period) or "indirect" carbon sequestration benefits (i.e., due to the independent adoption of project strategies by the remainder of the Village Councils, and expected to occur over a 20-year period).

h) An explicit re-accounting of carbon sequestration benefits expected to be achieved are described in the paragraphs below.

a) "Direct" carbon sequestration:

1) **Rangeland management (long-term):** Carbon sequestered in the vegetative biomass (above and below ground) of the area through a new natural resource management system will increase from the assumed present level of 6 tC/ha to about 10 tC/ha. To estimate the total carbon sequestered, the project document extrapolates over a 20-year period and 60,000 ha of land (roughly one fourth of the entire area controlled by the Gireigikh Rural Council) and reports maximum incremental carbon sequestered of 240,000 tC. Using the value of 2,532 ha, as cited above, the estimated maximum incremental carbon sequestered would actually be only 10,128 tC There is no representation regarding inter-temporal effects (i.e., at what point in the 20-year period this level is achieved).

2) **Rangeland improvement (near-term):** Carbon sequestered in the vegetative biomass (above and below ground) of the area through the use of drought-adapted grasses and native trees will increase from a present level of 6 tC/ha to about 12 tC/ha. The focus of this improvement is 100 ha for each of the 5 Village Councils. To estimate the total carbon sequestered, the project document extrapolates over the 500 ha (i.e., 100 ha in each of 5 Village Councils) of land and reports maximum incremental carbon sequestered of 3,000 tC.

3) **Stabilization of sand dunes (near-term):** Carbon sequestered in the vegetative biomass (above and below ground) of sand dunes in the area through the planting of trees/shrubs and grasses use of drought-adapted grasses and native trees will increase from a present level of approximately 0 tC/ha to about 21.8 tC/ha. The

focus of this improvement is a total area equivalent to 10 ha (5 km long by 20 m wide). The project document claims a maximum incremental carbon sequestration of 210 tC.[1]

4) **Stabilization of sand dunes (long-term, inferred):** The project documents claims credit for carbon sequestered through arresting future dune migration. Dune movement of around 15 meters per year was assumed, based on a rather dated (i.e., 1973) study. A 20-year time frame is assumed, yielding a total dune engulfment of 150 ha (i.e., 5 km long X 15 m/year X 20 years). Two further assumptions were made: a) that dunes would engulf lands having 8 tC/ha, and b) at the end of the 20-year period, 10% of the engulfed lands would have been restored naturally to the original 8 tC/ha level and the remainder would average about 5 tC/ha. The maximum incremental carbon sequestered is inferred to be 405 tC.[2]

5) **Creation of windbreaks (long-term):** Carbon sequestered in the vegetative biomass (above and below ground) of the boundaries of farms through the planting of trees will increase due to the planting of 195,000 trees along 195 km of farm boundaries (2 m wide). Each tree is assumed to achieve a maximum of 15 kg C (above and below ground), resulting in a maximum incremental carbon sequestration level of 2,925 tC in 20 years. Since trees are used for fuel and construction, it was assumed that half (i.e., stock) of the carbon would always be sequestered. Of the remaining half (i.e., yield), only one half would be harvested. Thus, the project document claims that 75% of the total carbon, or 2,190 tC will be sequestered.[3]

6) **Creation of windbreaks (long-term, inferred):** The project document claims credit for carbon sequestered in the vegetative biomass (above and below ground) of the windbreak trees due to the prevention of wind erosion. It was assumed, without any supporting justification, that windbreaks would reduce wind velocities in a 25 meter zone behind the windbreaks to the point where erosion would be eliminated completely. A protected area of 490 ha is assumed (i.e., 195,000 m X 25 m) which is currently degraded with a carbon sequestration level of 3 tC/ha. Upon windbreak maturity in 20 years, the carbon sequestration level in these areas would be about 8 tC/ha. Hence, the project document infers that the maximum incremental carbon sequestered will be 2,450 tC.[4]

b) "Indirect" carbon sequestration:

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[1] The figure reported by the project document is slightly incorrect. Total carbon sequestered should be about 218 tC using the figures cited in the project document. This difference, since small, is ignored for the purposes of this evaluation.

[2] This figure was calculated as follows for the 150 ha in question: carbon sequestered in the absence of dune engulfment equals (8 tC/ha)(150 ha), or 1200 tC. Carbon sequestered after dune engulfment equals (8 tC/ha)(0.1)(150 ha) + (5 tC/ha)(0.9)(150 ha), or 795 tC. Therefore, the incremental carbon sequestered due to prevention of sand dune migration is 1200 tC – 795 tC, or 405. The project document overestimates this increment to be 675 tC.

[3] Or, (2,925 tC)(0.5) + (2,925)(0.5)(0.5) = 2,194 tC (rounded to 2,190 tC)

[4] Or, (8 tC/ha – 3 tC/ha)(490 ha) = 2,450 tC.

1) **Extension of rangeland management activities:** The project document assumes that in 20 years the entire Gireigikh Rural Council will adopt the rangeland management strategies advanced in the pilot project. This would bring under management an additional 165,000 ha, and lead to an incremental level of carbon sequestered is equal to 660,000 tC.[5] Of this amount, the project document only claims half, or 330,000 tC, in an apparent attempt to be conservative. Applying an appropriate correction factor to estimate the additional area (i.e., 165/60*2,100), the actual incremental level of carbon sequestered is equal to 23,000 tC.

2) **Rangeland improvement:** The project document assumes that in 20 years the remaining 14 Village Councils will adopt the rangeland improvement strategy advanced in the pilot project. This would rehabilitate an additional 1,400 ha (i.e., 100 ha per village Council), and lead to an incremental level of carbon sequestered equal to 8,400 tC.[6] Of this amount, the project document only claims half, or about 4,000 tC.

3) **Stabilization of sand dunes:** The project document assumes that in 20 years the remaining 14 Village Councils will stabilize sand dunes in the area under their management at a rate equal to 10 times as was done in the pilot project (i.e., 1 km per Village Council in the pilot project; 130 km for the remaining 14 Village Councils, or 9.3 km/Village Council). This would result in an additional 260 ha (i.e., 130 km long by 20 m wide), and lead to an incremental level of carbon sequestered equal to 5,668 tC.[7] Of this amount, the project document only claims half, or about 2,835 tC.

4) **Stabilization of sand dunes (inferred):** The project document assumes that in 20 years the remaining 14 Village Councils will also arrest future dune migration through the stabilization of sand dunes in the area under their management. This is assumed to occur to the same degree as inferred in the calculations for pilot project (i.e., 15 meters per year per km of dune stabilized; 10% of engulfed lands restored naturally to 8 tC/ha; 90% of engulfed lands restored to only 5 tC/ha). This would result in an additional 3,900 ha (i.e., 130 km long X 15 m/year X 20 years), and lead to an incremental level of carbon sequestered equal to 10,530 tC.[8] Of this amount, the project document only claims half, or about 5,265 tC.

Note: the project document claims a total of indirect carbon sequestration benefits from dune stabilization of 11,505 tC. However, the above calculations only yield a total of 8,100 tC (i.e., 2,834 tC + 5,265 tC). The latter figures were used in the evaluation.

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[5] Or, (10 tC/ha – 6 tC/ha)(165,000 ha) = 660,000 tC

[6] Or, (12 tC/ha – 6 tC/ha)(1,400 ha) = 8,400 tC. Note: the project document reports this as 8,000 tC.

[7] Or, (21.8 tC/ha)(260 ha) = 5,668 tC. Note: the project document does not disaggregate this amount but lumps it into the total carbon sequestered (i.e., actual and inferred) from dune stabilization.

[8] This figure was calculated as follows for the 3,900 ha in question: carbon sequestered in the absence of dune engulfment equals (8 tC/ha)(3,900 ha), or 31,200 tC. Carbon sequestered after dune engulfment equals (8 tC/ha)(0.1)(3,900 ha) + (5 tC/ha)(0.9)(3,900 ha), or 20,670 tC. Therefore, the incremental carbon sequestered due to prevention of sand dune migration is 31,200 tC – 20,670 tC, or 10,530 tC. The project document overestimates this increment to be 675 tC.

5) **Creation of windbreaks:** The project document assumes that in 20 years the remaining 14 Village Councils will install windbreak in the area under their management at a slightly greater rate equal to 1.4 times as was done in the pilot project (i.e., 39 km per Village Council in the pilot project; 750 km for the remaining 14 Village Councils, or about 54 km/Village Council). Less clear were assumptions regarding planting density, carbon content at maturity, and harvest/stock shares. For the purposes of this evaluation, the same assumptions were used as were made for direct carbon benefits. (i.e., 1,000 trees per km of farm boundaries (2 m wide)), each tree achieving a maximum of 15 kg C (above and below ground), and 75% of total carbon in the tree would be sequestered. Assuming a 50% crediting level, the maximum incremental carbon sequestration level of 4,220 tC in 20 years.[9]

6) **Creation of windbreaks (inferred):** The project document claims credit for carbon sequestered in the vegetative biomass (above and below ground) of the windbreak trees due to the prevention of wind erosion. It was assumed, without any supporting justification, that windbreaks would reduce wind velocities in a 25 meter zone behind the windbreaks to the point where erosion would be eliminated completely. A protected area of 1,875 ha is assumed (i.e., 750,000 m X 25 m) which is currently degraded with a carbon sequestration level of 3 tC/ha. Upon windbreak maturity in 20 years, the carbon sequestration level in these areas would be about 8 tC/ha. Hence, the project document infers that the maximum incremental carbon sequestered will be 4,690 tC.[10]

Note: the project document claims a total of indirect carbon sequestration benefits from windbreaks of 7,980 tC. However, the above calculations yield a total of 8,910 tC (i.e., 4,220 tC + 4,690 tC). The latter figures were used in the evaluation.

i) In summary, the end of project situation for carbon sequestration benefits are as indicated in Table 1. Note that of the total "direct" benefit of 18,383 tC, only 5,400 tC are measurable. The balance is expected to occur over a 20-year period in the specific Village Councils targeted by the project. None of the "indirect" benefits are measurable as they are assumed to occur over a 20-year time frame and are in Village Councils that were not targeted by the project. For the purposes of this evaluation, only the direct benefit of 5,400 tC is considered subject to evaluation and verification. The remaining levels of carbon sequestration that claimed are evaluated in qualitative terms only.

Table 1: Summary of carbon sequestration benefits (in tC) claimed in the project document[11]

	"Direct" Benefits			"Indirect" Benefits		
Project Activity	At end of project	Expected after 20 years	Total (after 20 years)	Expected after 20 years	Inferred after 20 years	Total (after 20 years)
Rangeland management	0	10,128	10,128	27,731	0	27,731

[9] This figure was calculated as follows: (750 km)(1,000 trees/km)(0.015 tC/tree)(0.75)(0.5) = 4,220 tC

[10] Or, (8 tC/ha – 3 tC/ha)(1,875 ha)(0.5) = 4,690 tC.

[11] Corrected as per preceding text.

Rangeland improvement	3,000		3,000	4,000	0	4,000
Dune stabilization	210	405	615	2,835	5,265	8,100
Windbreaks	2,190	2,450	4,640	4,220	4,690	8,910
Total	5,400	12,983	18,383	38,786	9,955	48,741

c) Biodiversity:

a) There are several claims made in the project document concerning biodiversity improvements for animal and plant species as a result of project activities. However, these claims are very qualitative and rest on the premise that enhanced biodiversity will be a co-benefit of project activities. Unlike carbon sequestration, the project document makes no attempt to identify targets to achieve enhanced biodiversity (e.g., number of additional dorcas gazelles). The project document includes an additional biodiversity category, called "cultural diversity" which aims to represent the enhancement in local knowledge in natural resource management as a result of project activities. This would have been better classified as a development benefit (see below) related to capacity strengthening. Because the end-of-project situation is poorly defined, the end-of-project situation regarding biodiversity is impossible to objectively evaluate. Nevertheless, anecdotal evidence will be cited where available.

c) Atmospheric particulates:

b) The project document does not make any quantitative claim regarding reductions in particulates. Instead it suggests that guidelines "should" be established for similar efforts across the Sahelian zone, which "may" contribute to a reduction in particulate levels. Because the end-of-project situation is poorly defined, the end-of-project situation regarding particulates is impossible to objectively evaluate.

c) Development benefits:

c) These benefits are described in terms of local and governmental awareness of the viability of the project's approach to pastoral development. As such, this is a clear indicator of success that has been used in the evaluation process.

d) It's clear that to adequately capture the expected benefits of the project, a time frame longer that the project duration is needed. Most of the carbon sequestration benefits are only achievable after long periods of time, and will require a long-term monitoring commitment on the part of local government institutions such as the Range and Pasture Administration, as well as local communities. This is a problem that is not addressed adequately in the project design.

3. Beneficiaries

a) There are several sets of direct beneficiaries to the project, classified with respect to the type of project activity. While the end of project situation implies a population of indirect beneficiaries, none are explicitly mentioned in the project document.

b) A total of 5 Village Councils totaling 17 villages were targeted. The total population consisted of 5,500 Gawamaa (agropastoralists), and 600 Kawahla (transhumants). Activities concerned with rangeland improvement, water development, and paravet training were expected to benefit all households. In addition, there were a number of training activities were targeted to local individuals and leaders. Three distinct subsets of direct beneficiaries were identified:

Individuals that partake in certain project activities related to windbreak establishment, irrigated fodder productions, and experimental activities. This was estimated at between 20% and 30% of the total population.

Women who participate in the irrigated gardens. This was estimated at about 20% of the total number of women.

Individual who participate in the revolving credit programs. This was estimated at about 80% of the total population.

4. Modalities of Execution

a) One the project's key challenges was in overcoming its bad start. While project activities officially commenced in 1995, and managed by someone from the Range and Pasture Administration (RPA), the first two years represented a period of either inactivity or poor project performance. Shortcomings were evident at various levels. At the conceptual level, for some outputs there was a serious misunderstanding and/or a lack of appreciation on the part of project staff of the unique combination of community development and carbon sequestration aims. At the project administration level, there appears to be have been a serious issue arise regarding the management of project resources. And, at the execution level, there was poor coordination with the UNDP office in Khartoum.

b) As a result of these and other problems, there was serious consideration within the Arab States Bureau at GEF of canceling the entire effort. In 1997, project management was shifted away from the Range and Pasture Administration (although staff members from the RPA continued to work on the project). The new project management team (technical and administrative) was able to quickly implement a series of corrective measures and mount an aggressive program to catch up on the range of activities that had not been addressed, primarily training, institution building, and range rehabilitation. The net impact of the bad start-up was the need to extend the project for an additional year with an additional budget of about $500,000, the elimination of certain project activities (e.g., fielding the wildlife monitoring and evaluation specialist), and the scaling back of certain project activities (e.g., dune revegetation). On balance, the project was able to achieve the set of immediate objectives as put forth in the project document.

VI. Project Implementation

A. Activities

a) There are a total of 106 activities specified in the project document, organized under four immediate objectives and 24 specific outputs. Project activities can be broadly categorized as follows:

a) **Baseline Data collection:** To properly develop the scope for the various interventions of the project, baseline information was collected regarding land use, socioeconomic conditions, pastoral grazing patterns by transhumants, soil types, vegetation, animal population, and energy use devices. Most of these activities were scheduled to be among the first activities undertaken but experienced significant delays. Five land use boundary maps, one for each Village Council, and key to implementation of the project's rangeland rehabilitation activities, were completed satisfactorily. A summary report of other

baseline conditions regarding livestock populations, socioeconomic conditions, pastoral grazing patterns was prepared in 1997 and adequately reflected local conditions.

b) **Institution building:** One of the key features of the project was its focus on mobilizing community groups for planning and implementation of project activities. Project activities centered on the creation of two major committees, implementation and steering committees.

Implementation committees ("Tanfeez") were created, originally in each of the five Village Councils for the implementation of the range of project activities. At a certain point in the project, and driven by local developments, this framework was modified to include committees at the village level also. These village development committees (VDCs) were established in each of the 17 project villages in areas of grazing management, women's irrigated gardens, and credit systems. Membership consisted entirely of local village representatives and had good representation of women.

An overall coordination committee ("Tansigh") was also created for the entire Rural Council to be a type of higher-level oversight group consisting of the Chief and Judge of the Gireigikh Rural Council, women and Kawahla representatives, as well as project representatives. In addition, several coordination committees were established in each of the five Rural Councils (executive, and pastoral women issues). These project activities were well administered and benefited from a high level of interest and cooperation on the part of the local population.

a) **Training:** Training activities were significantly expanded relative to the original design in the project document. The project implemented a twofold training strategy. First, project staff were provided with targeted training on technical and administrative topics, including a course in Aleppo, Syria and several locally given courses on relevant technical topics (e.g., monitoring and evaluation).

Second, a number of individuals from each of the 17 project villages were selected to receive training on the range of project activities, including community development (e.g., soap production, macaroni production, handicrafts and food processing, women's irrigated gardens), natural resource management (e.g., range management, grazing systems, pest management, fodder production), credit systems, drought mitigation, animal production and health, and other topics. In total 45 training events were held over the 1998-1999 period.

A dominant theme of local training events was its emphasis on securing broad community participation by holding training events at the project villages and encouraging good representation of women. This activity is an important activity both for establishing and strengthening capacity in the newly created local institutions, and for project sustainability. The training program displayed an impressive coverage of relevant topics and was well administered and effective.

b) **Rangeland rehabilitation and improvement:** Most of the activities under the project's second immediate objective, an enhanced ecological capacity for rangeland regeneration, focus on range rehabilitation and improvement activities. This component comprised several activities related to the rehabilitation of portions of degraded areas, demonstration

of technologies and strategies, and testing/procurement of appropriate grass and tree species.

For the most part, rangeland rehabilitation and improvement efforts enjoyed good success. Clearly, implementation strategies showed a good level of community participation. The project's core message regarding the need for rangeland improvement, protection and management of natural resources was well received, understood and implemented at both the community and the private household level. Each of the major activities, namely sand dune revegetation, windbreak installation, and rangeland improvement showed a reasonably good record of achievement. The evaluation mission considers this to be one of the project's strong performance areas.

c) **Community development activities:** A fundamental assumption of the project concept was that in order to achieve long-term carbon sequestration benefits, it would be necessary to implement in parallel activities designed to meet near-term development needs of the local communities. Such activities were considered essential in helping to diversity the local production system and thereby contribute to easing pressures to extend cultivation on rain fed, marginal lands, where severe land degradation was taking place.

A total of 39 activities were implemented (or nearly 40% of all project activities) that focused on small-scale irrigated vegetable gardens, construction/management of water wells, sheep for goat substitution program, revolving funds to finance local income generating activities, central pharmacy for human/animal medicines, and a grain storage and credit program for drought preparedness. While many of these activities were implemented late in the project (i.e., during 1998 and 1999), this was not considered to be a liability to the overall efficacy of the effort. The identification of these activities in the project document typically did not indicate the implementation sequence since its purpose was to highlight the logical framework. Nevertheless, earlier implementation would have allowed for greater monitoring and performance review.

f) **Carbon sequestration monitoring activities:** These activities are discussed under the next section on monitoring and backstopping.

B. Quality of Monitoring and Backstopping

a) The project document called for an internal monitoring and evaluation (M&E) system to register achievements of the project and to indicate where corrective measures were necessary. M&E activities were intended to center on carbon sequestration, biodiversity, and community development activities. In addition, Project Performance Evaluation Reports (PPERs) as well a quarterly project progress reports were prepared but only for activities during the years 1998 and 1999. 1996, 1998 and 1999. Quarterly project progress reports were prepared for the fourth quarter 1997, 1998 and 1999. An annual Project Report was prepared for 1999 to replace the 1999 PPER. No mid-term external evaluation was conducted.

b) The evaluation mission considers that a serious shortcoming of the project was the organization and performance of its internal M&E units. Regarding the carbon sequestration M&E unit, the international consultant who was to provide essential input on the methodological approach was not fielded until August 1999, or about one year away from project termination. This was unfortunate as carbon sequestration was the major goal of the project, In the absence of

the international consultant, local consultants from the Institute of Environmental Studies at the University of Khartoum designed the sampling and testing approach, implemented a field program for data collection in 1998, and conducted laboratory analysis. A final report was published in November 1999.

c) The aim of sampling and testing activities was to make direct comparisons with the carbon monitoring results of a baseline survey conducted in 1996. Unfortunately, there were numerous difficulties. First, site locations for the 1996 sample were not identified adequately. The sampling conducted in 1998 did not necessarily obtain samples from the same location. Second, the methods used to collect woody biomass samples were not consistent between the 1996 and 1998 efforts. Third, after the baseline-testing program had been implemented, input received from the international consultant confirmed that there existed a major methodological gap in the approach – the lack of considering the soil carbon component. The lack of a suitably designed and vetted program to quantify the carbon sequestration benefits achieved by project activities calls into question the credibility of project claims in this regard.

d) Furthermore, carbon monitoring that was carried out was not entirely adequate to verify claims for the end of project situation. The report prepared by the Institute of Environmental Studies of the University of Khartoum[12] addressed only a portion of the sequestration levels anticipated in the end of project situation. It also expanded the scope to address areas not addressed in the project document (see table below). The results of carbon monitoring will be discussed under the relevant outputs.

Table 2: Summary of carbon sequestration monitoring activities

Carbon sequestration Category	Addressed in Project Document	Addressed in Monitoring Program
Rangeland Management	Yes	Yes
Rangeland Improvement	Yes	Yes
Dune stabilization	Yes	No
Windbreaks	Yes	No
Soil Organic carbon	No	Yes
Reduced fuelwood demand	No	Yes
Reduced construction wood demand	No	Yes [a]
Change in land use system	No	Yes [a]

[a] *These are not actually monitored but rather projected on the basis of a set of inferences and assumptions*

[12] *Estimation and Monitoring of Carbon Sequestration in Gireigikh Community Based Rangeland Rehabilitation Project (SUD/93/G31),* November 1999.

a) Regarding biodiversity, the M&E unit for related activities was never fielded. This appears to have been justified on the grounds that a) biodiversity was not a well-defined objective in the project document and b) funds could be put to better use in training and other more immediate carbon sequestration and community development activities. Regarding community development, the M&E unit was not established until late in project (1998). Nevertheless, adequate training was provided and the unit was able to provide useful inputs to the overall project in terms of providing the status of development activities and socioeconomic information required for periodic evaluation reports.

b) At this time, the project lacks accurate estimates about the rate of soil organic matter that might be occurring under improved management and rehabilitation. While there was a soil-monitoring component, it was not possible to compare it to a baseline condition because no such measurements were made at the time of the 1996 baseline study. The evaluation team considers that the project's monitoring and evaluation activities were unsatisfactory, and considers the need to develop a flexible and practical protocol for verifying carbon changes into the future as a priority for follow-up activities. Given the fact that carbon sequestration and biodiversity were explicitly mentioned as key outcomes of the project (i.e., the end of project situation), the lack of timely and well-executed M&E activities, particularly with regard to the monitoring of carbon sequestration, represents a serious shortcoming of the project.

VII. Project Results

A. Relevance

a) From a national and international perspective, the relevance of SUD/93/G31 has remained high during the years since the project's inception with regard to its carbon sequestration objectives. Carbon dioxide is accumulating in the atmosphere due to variety of causes such as the combustion of fossil fuels, deforestation, and land use changes. The current international framework for which credit could be envisaged for carbon sequestration efforts is the Clean Development Mechanism of the Kyoto Protocol. While at present, there are no provisions for crediting carbon sequestration; there remains strong interest on the part of the international community to explore soil conservation and land management activities as part of the suite of options. By identifying local obstacles and challenges to securing long-term carbon storage in rural communities, this pilot project provides important case study input to the ongoing debate.

b) From a local villager perspective, global warming is clearly not a major concern: whereas food and water security are overriding concerns. It is unlikely that the local population would have been willing or able to implement alternative land management techniques no matter how degraded the land, apart from the community development incentives that were provided as an important parallel effort of the project. The crucial question regarding relevance is whether carbon sequestration projects such as the Gireigikh project, when applied on a larger scale, can bring about global environmental benefits as well as significant local economic benefits. The evaluation team's attempt at an answer to this question is provided later in this report under follow-up.

B. Efficiency

a) Efficiency can be measured on several different levels: administrative, economic, and developmental. From an administrative perspective, the lack of progress during the first two years of the project disadvantaged the project in terms of overall project performance.

b) The economic efficiency of the project could arguably be measured against the cost of achieving long-term carbon storage. This, however, is problematic because near-term carbon storage has not been adequately verified by the project and there are no plans in place to monitor and verify long-term carbon storage claims. If one accepts the claims of the project that project activities will lead to direct and indirect, incremental carbon storage of nearly 61,000 tonnes in 20 years, then the cost of stored carbon (undiscounted) is low relative to the full range of options, about $3.50/tC. Such a calculation, however, implies strong sustainability in which the full local transformation away from the cultivation of marginal lands occurs without any future funding support. On the other hand, if one considers only direct incremental carbon stored by the end of project activities, then the cost of stored carbon is very high, about $375/tC. Without a more rigorous field verification program, posing the actual costs of carbon storage is highly speculative.

c) From a local development perspective, the fact that community participation was high across the range of activities, and in fact exceeded project goals in some respects, suggests that the training programs and extension activities were highly effective.

C. Outputs

1.1 Appropriate field base-line data collected to facilitate ongoing work of project

a) This output was a key starting point for the project as many subsequent activities depended on having reliable information regarding land use, socioeconomic factors, soil types, and biomass cover, and agricultural practices. The activities were originally scheduled to take place in the first year of the project (i.e., 1995) but unfortunately did not occur until 1998. Nevertheless, a comprehensive set of baseline data was systematically collected and of sufficiently high quality to be of central use to the subsequent project activities.

b) The GPS expert prepared a line boundary map for the project area. This map showed the approximate boundaries of the five Village Councils and was relied upon by the agricultural specialist to show the different types of vegetation prevailing within each of the Village Councils. In addition, the GIS expert conducted a survey to document land uses among the Village Councils, together with a transhumance map showing the livestock movements of the Kawahla and Gawamaa tribes. This map was used by the veterinarian and range management specialists to track livestock movements for the purpose of identifying future plans for distribution of forage, and camping of animal vaccination teams. A rapid rural appraisal of people's knowledge and practices was conducted that was broadly referred to and used as background information by the project's various specialists.

1.2 Appropriate community institutional structure established for community-based management of natural resources and management of development.

c) Two distinct local institutions were created. First, "Legnat al Tanfeez" (hereafter, Tanfeez) committees were community-based umbrella institutions designed to implement project

activities. A total of five committees, one for each of the five Village Councils in the project area, were established. Each of these five committees was designed to incorporate 6 sub-committees aligned with the thematic issues of the project, namely grazing management, water management, women's vegetable gardens, pastoral women development, men's credit and women's credit. Second, one "Legnat al Tansigh" (hereafter, Tansigh) committee was established as a higher institution whose purpose was to act as a sort of co-ordination and advisory panel with loosely defined authority to monitor and direct Tanfeez activities. Membership consisted of one representative for each Tanfeez Committee, the chief and judge of Giraigikh Rural Council, and senior project staff. The institutional design of each of these institutions explicitly considered membership of both men and women as a key target, as well as the local tribal composition.

d) From the beginning of the implementation of the project, the need to be flexible regarding the creation and strengthening of local institutions was observed. This institutional set-up was modified in June 1998 as a result of a locally-driven imitative. A wide consensus emerged among beneficiaries that the village community rather than the Village Council would be a better institutional focus for the Tanfeez committees. This led to the emergence of Village Development Committees (VDC). The key difference was the evolution from larger more heterogeneous Village Councils toward the smaller, more homogenous village units. With respect to internal organization, the VDCs essentially duplicated the structure of the Tanfeez (i.e., retained functions of Chairperson, Secretary and Treasurer) and the six thematic subcomittees. By the project's end, a total of 17 VDCs were in operation. No changes were made to the structure of the Tansigh committee.

e) This modification in the institutional set-up represents a reasonable outcome from a process of dialogue with the concerned communities. It's also a good indication that project's approach was sufficiently flexible to accommodate a growing comprehension and appreciation of local values, norms, and indigenous social structures. It's worth noting that the project document provides sufficient room for such an evolution by stating, "flexibility will be maintained to allow institutions to evolve towards an appropriate structure if and when the need arises."

f) The members of the organized institutions were trained in communal land management techniques, involving rotational strategies, optimal grazing periods, and calculation of land carrying capacity. The carbon-monitoring program attempted to verify the direct sequestration levels attained by this output by conducting direct field measurements after the rainy season in 1998 in open rangeland areas. Both above- and below-ground herbaceous biomass was measured at 20 sampling sites spread out across the 5 Village Councils. At the same 20 sites, only above-ground woody biomass was measured. Comparative data for herbaceous biomass was available from a baseline survey in 1996, also conducted in October just after the rainy season. Unfortunately, comparative data for woody biomass was not available. The results are summarized in Table 3.

Table 3: Carbon sequestration in the open rangeland[13]

[13] Note: The EIS used simple averages in its analysis. The figures reported in the tables above represent a weighted average and are somewhat different that results reported in the EIS study. Using weighting techniques better represents the spatial variability of the sampling results.

Category	Measure	1996	1998	Difference
Herbaceous carbon	Average carbon density, weighted (tC/ha)	0.22	0.36	0.13
	Estimated carbon sequestered, weighted (tC)	465	742	277
Woody carbon (above ground)	Average carbon density, weighted (tC/ha)	NA	1.27	NA
	Estimated carbon sequestered, weighted (tC)	NA	2,636	NA
Woody Carbon (below ground)	Average carbon density, weighted (tC/ha)	NA	0.51	NA
	Estimated carbon sequestered, weighted (tC)	NA	1,054	NA
Soil organic carbon	Average carbon density, weighted (tC/ha)	NA	5.36	NA
	Estimated carbon sequestered, weighted (tC)	NA	11,165	NA

a) To assess whether the difference in herbaceous carbon between 1996 and 1998 in the above table is statistically significant, an analysis of paired samples was conducted on the sampling data from the EIS report. At a 95% confidence level, the difference between the two years is 0.13 tC/ha +/- 0.11 tC/ha. The fact that the range is greater than zero (i.e., minimum difference of 0.02 tC/ha; maximum difference of 0.25 tC/ha) indicates that there is a 95% probability that difference between the two years is real. However, many conditions other than the project's new management techniques, could account for this difference – rainfall, temperature, and so on. To establish the effect of improved land management techniques, it may have been better to take two adjacent plots in the same year (i.e., split-plot design), one subject to new management techniques and other not subject to the new techniques.

b) The carbon-monitoring program also attempted to quantify the below ground woody carbon sequestered by tree roots in open rangelands. Direct field measurements were not made in the Baseline survey in 1996. Uprooting 16 trees and measuring the length of the root system represented the sampling approach. On average, it was learned that roots of tree in the study area contribute about 40% of the biomass. Thus, in 1998 the total below-ground carbon is estimated to be about 1,054 tC (i.e., 40% of 2,636 tC). With an open rangeland area equal to 2,083 ha, the average carbon density of below-ground woody biomass is estimated as 0.51 tC/ha. No comparison can be made to 1996 results because this data had not been collected.

c) The carbon-monitoring program also attempted to quantify the soil organic carbon sequestered in open rangelands. Direct field measurements were not made in the Baseline survey in 1996. The approach to estimating soil organic carbon was to take soil sample from the upper 30 cm of ground cover at the same 20 sampling sites and test using a wet oxidation-titration method. The simple average of soil carbon content was estimated to be 0.119% of topsoil. Thus,

in 1998 the total soil carbon density is estimated to be about 5.36 tC/ha.[14] With an open rangeland area equal to 2,083 ha, the average soil carbon level is estimated as 11,165 tC. No comparison can be made to 1996 results because this data had not been collected.

d) It is noteworthy that these levels of carbon storage per hectare are far below estimates made in the project document. It had been assumed that the above- and below-ground carbon stored in biomass was 6 tC/ha prior to project activities. From the summary in Table 3 for 1998, the total was estimated at 2.14 tC/ha after some project activities, or about a third less. However, since it's the incremental carbon storage that is important, the fact the starting level is inaccurate is not critical.

1.3 Five land use master plans, one for each Village Council, developed with full participation of the people, and formalized within the local government structure, communicated to the entire project population, and used as the basis of action over the ensuing years.

a) The intent of this output was to provide a basis by which to install a mechanism for public supervision and control to ensure compliance with a master plan for land use. It became clear over the course of trying to implement this activity that there was significant resistance on the part of the Tansigh and Tanfeez committees to implementing a formal recognition of territorial rights with actual boundaries marked by rocks or other locally available materials. However, this was not a development that compromised subsequent project interventions. In fact, as a compromise to achieve an equivalent result, the project management was able to prevail upon the Gireigikh Rural Council to introduce a new public decree that codified the range management strategies advocated by the project and to increase the ratio of rangeland to cultivated land from its level at project inception of 0.1 to close to 2.0.[15] As such, this output was considered satisfactory by the evaluation team.

1.4 A detailed project workplan developed by the Tanfeez and Tansigh committees that specifies the schedule of project activities, the potential direct recipients and the location of activities based on the land boundaries and land use maps.

b) Detailed workplans were prepared by the project management team, not by the Tanfeez and Tansigh committees. This was an adequate response to practical on-site realities. Nevertheless, the specific activities identified in the project document to be carried out as part of this output were performed. These focused on the use of soil and vegetation maps that had been developed as part of the project were used to identify potential sites for revegetation activities.

1.5 Enhanced capability of the local leaders and project staff to carry out their mandate.

c) The project envisioned an extensive training program to build awareness and support for the new rangeland management techniques and other innovations throughout the Gireigikh RC. There were three area where major training activities were undertaken: a) planning, operation and management of ventures started up within the rangeland rehabilitation initiative; b)

[14] Calculated assuming a soil density of 1.5 kg/liter; depth of auger of 30 cm; auger width of 5.3 cm; and a volume of soil of 667 cubic cm.

[15] On a percentage basis, the area for rangelands would be targeted to increase from 11% to 65%, while the area for cultivated land would be targeted to decrease from 89% to 35%.

Sharpening the professional competence and skills of project staff through exposure to focused training (within Sudan and abroad), and exchange of experience with other projects operational in the adjacent areas, and c) collaboration with the Kordofan State RPA and other governmental partners. The original training budget, about $39,000, was considered severely inadequate to carry out the training mandate and was gradually increased threefold to about $113,000 over a 2-year period between 1998 and 1999.[16]

d) This significant increase in the training budget was an appropriate response to the fundamental need to enhance knowledge among the local communities of the connection between current management practices and sustainable development. The different training activities implemented have helped community institutions improve their capacity for planning, management and action. It's apparent that, with varying degrees of efficiency and effectiveness, the cumulative impact of the different training interventions is an ability to identify problems and develop solutions with the role of the project being mainly confined to extending support to these initiatives rather than replacing community effort or the roles of its various institutions. The policy of focused training and advice has relatively helped define a better sense of leadership and maintain some momentum to ensure that community actions could achieve some sustained results.

1.6 Community mobilization teams established and trained to carry out extension work on environmental education and technical innovations.

a) In the context of the participatory approach, and to strengthen the potential for local activities to continue beyond the life of the project, members of the local community were identified and trained to assist in project implementation. Over the life of the project, a total of 18 individuals -- 7 women and 11 men representing the 5 Village Councils and Kawahla tribe -- were recruited and trained to carry out extension work, participate/lead training workshops and seminars, facilitate the local introduction of new technologies, and help to mobilize community support for project activities. Each of the 17 villages had at least one such individual who partnered with project staff in extension activities. While at first the project needed to provide remuneration in order to enlist the support of these individuals, it is noteworthy that by the time of the evaluation mission, most of them (14 out the 18) were still carrying out their tasks, but on a voluntary basis. This suggests that project ideas have been accepted into local patterns of voluntary labor and organization. The efforts made by the project to institutionalize the planning process at the community level have the potential to have a lasting impact to empower local communities.

b) Community mobilization efforts have blended well within the overall awareness raising and consensus building that were being addressed within the context of the VDCs. While the efficacy of the mobilization effort ranges from village to village, it's clear that awareness has been sufficiently built in most of the 17 village communities. In some villages, community members have proposed and pursued follow-up ideas that reflect perceptions of their own capacities, resources, and immediate development needs, including the productive use of their labor assets. In these villages, the project has facilitated interactions between people and factions on near-term development priorities, and has been effective in promoting the perception that project represent a socially responsible business approach that can advance local socio-economic and

[16] Budget revision coded "L" dated 17 February 2000.

environmental interests. Nevertheless, there is evidence that in other villages, apparently due to either improper planning or lack of effectiveness the community mobilization team, the project hasn't succeeded in promoting sufficient realization of the need to be more proactive in addressing problems in resource management.

2.1 Up to 5 kilometers of denuded sand dunes threatening economically sensitive areas and/or project activities, revegetated.

a) Several activities were envisaged with a view to strengthening the area's resistance to sand dune encroachment. These included identifying the best sites for revegetation, procurement of tree and grass seedlings, and the organization by the Tansigh committee of local volunteers to stabilize the dunes. Initially, sand dunes in the proximity of the villages of El-Meliesa and Es-Sabahia were chosen. Attempts at stabilizing the active dunes in this region proved ineffective primarily due to the fact that these were not project villages, and thus had little appreciation for the aims of the project. Dune stabilization efforts, which had begun in 1996, were being interpreted by local villagers as a way for the project to claim ownership at some future date. As a result of increasing local opposition, all dune stabilization in these villages was stopped in 1997, resulting in the desiccation of those seedlings of dune-fixing species that had been transplanted. This outcome confirms the importance of a participatory approach to implementation as a means of assuring that project activities actually benefit the rural poor.

b) The project then shifted its focus to the town of Bara, considered to be an economically sensitive area though rather far removed from direct project activities in villages. During 2000, a large sand dune just south of the town was identified and selected for a second attempt at dune stabilization. Contact was made with the Forests National Corporation of North Kordofan to enlist their participation and to help coordinate efforts. In contrast to the earlier attempt, community participation was high due to better explanation of the purpose of the intervention and expected future benefits, as well as the absence of controversy concerning land use.

c) The actual approach taken by the project differed from the design outlined in the project document. Rather than revegetating a block with dimensions equal to 5 km long by 20 meters wide (or 10 hectares), a total of eight blocks with dimensions 137.5 meters on a side (or 15 hectares), were planted with *Acacia* and *Panicum* species. From the perspective of near-term carbon sequestration, the larger coverage area is potentially more attractive. However, from the perspective of long-term sequestration, which was explicitly stated as an end of project situation, the reduced length protected (i.e., 1.1 km instead of 5 km) implies that roughly one fifth less than the 150 ha claimed will be protected from future dune engulfment. Nevertheless, in the context of overall direct carbon sequestration goals set in the project document; carbon sequestration goals through dune stabilization were small, equaling 4% of near-term sequestration benefits and 0.25% of long-term benefits.

d) The carbon-monitoring program did not attempt to verify the direct sequestration levels attained by this output. Nor was there an attempt to monitor the indirect effect of sand dune revegetation on limiting sand dune migration. As a result, the 210 tC in direct carbon sequestration benefits at the end of the project can not be verified.

2.2 Up to 130 farms provided with windbreaks (195 km total windbreaks).

a) The project selected farms on which to plant windbreaks on the basis of individual farmer applications, coordinated through the VDCs. By the end of the project, a total of 166 farmers had submitted applications for the installation of windbreaks on their farm borders. *Acacia Senegal* and *Ziziphus spini-christi* were the major tree species requested on account of their perceived adaptability and economic importance. By March 1999, a total of 51 km of windbreaks had been established. By the end of the project, an additional 57 km had been installed, resulting in a total farm boundary length of 108 km protected by windbreaks, and corresponding to a total of 304 farms. This represents a little over half of the 195 km targeted in the project document.

b) The reason why the project failed to meet the target is due in part to the difficult start to the project in its first two years, and also by the difficulty in obtaining timely budget approval for activities in the last months of the project (intended for supporting activities to make up for earlier missed milestones).

c) The carbon-monitoring program made no attempt to verify the direct sequestration levels attained by this output. Nor was there an attempt to monitor the effect of windbreak protection on reducing erosion. Hence, the 2,190 tC in direct carbon sequestration benefits at the end of the project can not be verified.

2.3 At least 100 hectares of rangeland improved and properly managed.

a) While the immediate objective states that 100 hectares are to be improved and properly managed, it should be interpreted to mean 100 hectares per Village Council, or 500 hectares total. This is clear intent of the description of the end of project situation in the project document. The strategy employed in rangeland improvement and management especially impressed the evaluation team because of the extent of "buy-in" evident at both the community and individual (i.e., private, households) levels. The project's core message regarding the need for rangeland improvement, protection and management of natural resources was well received, understood and implemented at two levels, the community and the private household.

b) At the community level, the project document envisaged project staff to work with the Tansigh and Tanfeez committees to set aside between 10 ha and up to 10% of total land area in each of the five Village Councils as protected area. This implies a range between 50 hectares (i.e., 10 ha for each of the 5 Village Councils) and 2,348 hectares (i.e., 10% of the total land area of 23,476 ha). Thus, there existed a discrepancy between this range and the prevailing assumption used to define the end of project situation, 500 hectares, that the project management reconciled by aiming for a total target of 100 hectares across the 5 Village Councils.

c) At the time of project inception, community rangelands accounted for 2,532 ha out of a total of 23,476 ha controlled by the 5 Village Councils, or about 11%. The intention was that these land tracts be offered voluntarily by the communities and be put under protection from grazing and fuelwood collection until sufficiently rehabilitated. Project staff developed materials that were effective in explaining the reasons for these tracts, plans for their rehabilitation/improvement, and plans for their sustainable exploitation by villagers on a permanent basis. By the end of the project, a total of 700 ha had been voluntarily set aside by the communities, representing nearly 30% of communal grazing lands, and a seven-fold increase from the initial target. Seeding using different range grass and legume species took place during the rainy seasons of 1997, 1998, and 1999. Grazing allotments were opened up for limited grazing in 1999.

d) At the private household level, there was nearly as much private land, 543 ha voluntarily set aside by households for use as individual grazing allotments. An additional 166 more applications for private grazing allotments had been received by project staff but not processed by the time of the terminal evaluation. This was a happy though completely unexpected development of the project as only a community-based approach had been designed. It is a particularly noteworthy outcome as private lands are primarily those that are subject to cultivation decisions and which, by virtue of the fact that vegetation is cleared before cultivation making the topsoil vulnerable to wind erosion, have shown the greatest evidence of land degradation. The mission team gathered enough anecdotal evidence from villages to be persuaded that private grazing allotments were actually considered more desirable that than communal allotments because of the perception that the benefits of communal grazing allotments were distributed unequally.

e) The central nursery (see Output 3.3), which had been established in Greigikh, was a primary source for the seedlings for range improvement on communal and private grazing allotments. The evaluation team considers the level of success in transplanting species from the central nursery to degraded rangelands as mixed. For trees, seedlings were typically monitored in the nursery for a period of three to four months before being transplanted into the rangelands. So, by the time they were transplanted they had attained sufficient height and were able to withstand the harsh conditions in the field. In contrast, the transplanting of perennial grass species from the nursery to rangelands was clearly unsuccessful. A high mortality rate was documented in the planting of *Cenchrous*, *Panicum turgidum*, and *Andropogon gayanus* grass species. Ensuing ad hoc testing convinced project staff that it would be more effective to seed rangelands directly.

f) In the early years of the project, 1995 and 1996, the effectiveness of rangeland improvement activities was severely compromised by errors on the part of the then-management team. According to the project document, rangeland improvement activities were part of an overall strategy to help foster a transition away from cultivation on marginal land toward livestock husbandry. Hence, the types of grass seedlings applied to communal rangelands should have been able to meet dual objectives of storing carbon and providing annual fodder supplies. However, grass species like Aristida pallida (*Um Semaima)*, which is an indigenous grass during these early years were chosen based on their potential to provide green cover and were, in fact, unpalatable to sheep. While this fundamental error disadvantaged the project in terms of what it might have eventually achieved, it was picked up and corrected as part of the oversight process by the UNDP office in Khartoum.

g) From 1996 onward, intensive seeding activities were undertaken in an effort to make up for lost time. Even in 2000, the final year of the project, a total of 285 sacks[17] of different grass species (*Zornia*, *Cenchrus, Blepharis*, and *Dactyloctinium*) were reseeded, in addition to 78 sacks of pelleted seeds that will increase water holding capacity and enhance germination and seedling establishment. There was a high success with *Zornia* and *Cenchrus* , a medium success with *Blepharis* and a complete failure with *Dactyloctinium*. Grass cuttings of *Panicum turgidum*, *Cyperus mutundii* and *Andropogon gayanus* to revegetate degraded arid rangelands had a high success with the first two species Introduction of leguminous species like *Clitoria*

[17] A sack of Zornia, Cenchrus, Blepharis and Dactyloctenium weighs 30, 10, 20 and 15kg, respectively.

ternata to improve a range which was a predominantly grassland was tried with varying degrees of success from one site to the other.

h) The carbon-monitoring program attempted to verify the direct sequestration levels attained by this output by conducting direct field measurements after the rainy season in 1998 in grazing allotment areas. There was no comparative data available from the 1996 baseline survey. However, data had been collected at the sites in 1997 so a comparison was possible over a 1-year period. Both above- and below-ground herbaceous biomass was measured at 16 sampling sites spread out across the 5 Village Councils, representing a total allotment area 448.5 ha.[18] At the same 16 sites, only above-ground woody biomass was measured. The results are summarized in Table 4.

Table 4: Carbon sequestration in the grazing allotments[19]

Category	Measure	1997	1998	Difference
Herbaceous carbon	Average carbon density, weighted (tC/ha)	0.49	0.57	0.08
	Estimated carbon sequestered, weighted (tC)	217	256	38
Woody carbon (above ground)	Average carbon density, weighted (tC/ha)	NA	3.24	NA
	Estimated carbon sequestered, weighted (tC)	NA	1,451	NA
Woody Carbon (below ground)	Average carbon density, weighted (tC/ha)	NA	1.29	NA
	Estimated carbon sequestered, weighted (tC)	NA	580	NA
Soil organic carbon	Average carbon density, weighted (tC/ha)	NA	3.24	NA
	Estimated carbon sequestered, weighted (tC)	NA	1,451	NA

a) To assess whether the difference in herbaceous carbon between 1996 and 1998 in the above table is statistically significant, an analysis of paired samples was conducted on the sampling data from the EIS report. At a 95% confidence level, the difference between the two years is 0.08 tC/ha +/- 0.18 tC/ha. The fact that the range passes through zero (i.e., minimum difference of -0.10 tC/ha; maximum difference of 0.27 tC/ha) indicates that there is a 95% probability that difference between the two years is not real. It should also be noted that the EIS report indicates a large increase (i.e., 4.2 times more) in total carbon sequestered in woody biomass between 1997 and 1998. The values for 1997 have not been included in the above table because

[18] This represents about 150 ha less than the actual allotment area achieved by the project. No subsequent monitoring was done to document the carbon sequestration characteristics in this additional area.

[19] Note: The EIS used simple averages in its analysis. The figures reported in the tables above represent a weighted average and are somewhat different that results reported in the EIS study. Using weighting techniques better represents the spatial variability of the sampling results.

inconsistent sampling methodologies were applied, this rendering a comparison in the sampling invalid.

b) The carbon-monitoring program also attempted to quantify the below ground woody carbon sequestered by tree roots in the grazing allotments. Direct field measurements were not made in the Baseline survey in 1996. The same percentage as was used in the open rangeland areas was used to represent below-ground woody biomass in the grazing allotments. Thus, in 1998 the total below-ground carbon is estimated to be about 580 tC (i.e., 40% of 1,451 tC). With a total grazing allotment area equal to 448.5 ha, the average carbon density of below-ground woody biomass is estimated as 1.29 tC/ha. No comparison can be made to 1996 results because this data had not been collected.

c) The carbon-monitoring program also attempted to quantify the soil organic carbon sequestered in grazing allotments. Direct field measurements were not made in the Baseline survey in 1996. As with open rangelands, the approach to estimating soil organic carbon was to take soil sample from the upper 30 cm of ground cover at the same 16 sampling sites and test using a wet oxidation-titration method. The simple average of soil carbon content was estimated to be 0.115% of topsoil. Thus, in 1998 the total soil carbon density is estimated to be about 5.18 tC/ha.[20] With a grazing allotment area equal to 448.5 ha, the average soil carbon level is estimated as 2,323 tC. No comparison can be made to 1996 results because this data had not been collected.

d) It is noteworthy that these levels of carbon storage per hectare are much closer to the estimates made in the project document than those in open rangelands. It had been assumed that the above- and below-ground carbon stored in biomass was 6 tC/ha prior to project activities. From the summary in Table 3 for 1998, the total was estimated at 5.1 tC/ha after some project activities, or only about a fifth less.

2.4 An environmental monitoring and evaluation unit established.

a) The evaluation team considers the environmental monitoring and evaluation (M&E) output of the project to be its weakest element. The project document envisaged the M&E unit to be composed of project staff and representatives of village grazing subcommittees, and backstopped by an international consultant on carbon sequestration. The major goal of the M&E unit was to develop the sampling and testing protocols for verifying any carbon sequestration claims of the project. Major results were to be evaluated twice - at the mid-term and at the end of the project. In addition, the biodiversity goals of the project were to be monitored by a wildlife M&E unit.

b) Given the link between verifying carbon sequestration levels and a successful end of project situation, the environmental M&E unit should have been established early and supported. From the perspective of schedule, this output was quite late in developing and when finally implemented fell well short of stated objectives. It was not until May 1998, or three years into the project that the environmental M&E unit was established and training activities commenced. The international consultant on carbon sequestration, who was to provide essential input on the methodology for monitoring and assessing direct and indirect carbon sequestration, was not fielded until August 1999 (or 1 year away from project termination), and then stayed only a few

[20] Calculated assuming a soil density of 1.5 kg/liter; depth of auger of 30 cm; auger width of 5.3 cm; and a volume of soil of 667 cubic cm.

days at the project site. However, by that time a local consultant had already designed the carbon sequestration-testing program and completed a full-scale assessment, all without the benefit of external technical input.[21] After reviewing the testing program design and outputs, the international consultant observed that the data collected for the assessment of carbon sequestration did not include the most important aspect of the sequestration system, the soil carbon component. He recommended that the project should collect soil samples to measure the carbon content and be added to the data collected on vegetation.

c) The local consultant prepared a report documenting the incremental carbon added as a result of project activities. Questions and issues related to the results are discussed elsewhere in this evaluation. The local consultant also developed sampling guidelines for use by the environmental M&E unit in the final year of the project. The M&E unit received training offered by the project staff on collection of vegetation samples from grazing allotments and open rangelands measurements, and preparation of samples for transport to the Agricultural Research Station at El-Obeid for weighing and determination of carbon contents. At the time of project termination, no arrangements had been put in place for future monitoring of carbon sequestered. This is a critical activity that is needed to substantiate long-term performance.

d) The wildlife consultant was never fielded due to the fact that the funding required to carry out the limited tasks associated monitoring the wildlife population was diverted to a number of other community development and training activities.

e) Project progress reports were prepared on a regular basis. Various reports were prepared according to UNDP requirements, which were helpful in project evaluation. A system of financial monitoring was also in place and a complete inventory of project equipment was prepared.

3.1 Up to 5 new shallow hand dug wells and 10 rehabilitated shallow wells in the project area (the exact number to be determined by the preparatory assistance phase sub-contract on water development feasibility study.

a) In response to emerging information about villager needs and synergies with other project aims, the original specifications were modified. Rather than shallow hand dug wells, a total of 17 deep bore-holes, or one per project village, with reasonable pumping and fencing facilities were constructed. This effort was completed in June 1998, or about 3 years behind schedule, at a total cost of about US$ 160,000. Six of the wells were equipped with diesel pumps, while the remainder were equipped with hands pumps. In one village where the plans called for the installation of a hand pump, the Village Development Committee opted to pay the incremental cost for the installation of a diesel pump. At the time of the evaluation mission, some of wells were either unutilized or underutilized. This was not a liability but rather the result of local decisions regarding plans for the irrigated gardens.

3.2 A water management sub-committee created in each village Council to manage the public access wells, close attention being paid to the methods used by CARE and UNICEF in Kordofan.

[21] The local organization retained to design and carry out the testing program was the Institute of Environmental Studies of the University of Khartoum.

b) Water management sub-committees were established in October 1996. These were established at the Village Council level, as originally anticipated in the project document. In 1998, these sub-committees became localized at the village level due to the evolving perception among villagers that it was easier to implement and coordinate water management with smaller groups. A total of 144 persons (97 male and 47 female) were formally trained in the practical operation and management of water pumps. Moreover, some sub-committee members were selected and provided with further training to do maintenance work for the diesel pumps used for the fodder production farms. In providing training to village subcommittee members, project staff was guided by materials and methods used by CARE and UNICEF for managing access to public wells. These included simple and field-proven techniques on hygiene, maintenance and management training to run these facilities as financially self-supporting ventures.

c) The project's approach to providing both access to safe drinking water for people as well as water for livestock and irrigation appears to be effective. Important social and institutional aspects such as ownership and management responsibilities were addressed explicitly in the training program. These appear to be particularly effective, given evidence of high motivation on the part of local villagers for whom the water pumps represented essential hardware where there are very few asset-based means of production. It was clear that there was both a high level of leadership commitment on the part of the village water subcommittees, as well as participation on the part of the village communities charged with operating and maintaining the equipment.

3.3 A project experimental substation established and operational with fodder trials and nursery, and used for demonstration and extension of project innovations.

a) A 10-feddan experimental sub-station was established in Gireigikh in October 1998, well behind schedule.[22] It was equipped with a nursery capable of conducting fodder production tests. One large diameter bore hole was dug and equipped with a diesel driven pump and an irrigation system of PVC pipes along with sheds constructed from local materials (bamboo stems). Activities at the experimental station centered around the production of grasses, shrubs, and tree seedlings to be transplanted into rangelands as wind breaks and as ground cover. In addition, the substation was used to test drought tolerant crop species and some adapted forage species that were to be introduced to the project area. Furthermore, the station was used to produce vegetables crops. A small amount of fruit trees were also planted.

b) Testing trials began in December of 1998. Leguminous forage species (*Clitoria* and *Zornia*) and adapted grass species (*Panicum* and *Cenchrus)* in addition to *Blepharis* were tested in the station along with newly adapted varieties of millet, sorghum and sesame released by the Agricultural Research Corporation at El Obeid. Local people conducted all planting and testing activities at the sub-station while the project's range specialist, horticulturist, and forester provided technical support and supervision. During 2000, a total number of 1,501 of Neem tree seedlings and 565 Henna tree seedlings were transplanted from nursery and planted in women's gardens and around villages. During the second quarter of year 2001 a total of 1500 seedlings of various trees were produced at the Swedish Sudanese Association (SSA) village nurseries, in addition to a total of 49,000 seedlings produced at the Gireigikh central nursery and distributed to village allotments.

[22] A "feddan" is a locally used unit of area. One feddan is approximately equal to 0.42 hectares.

c) Despite the delay in starting up the operation of the nursery, the impact on the project appears to be negligible as training activities were effective in demonstrating to local people the techniques of growing crops and the different cultural practices such as sowing methods, seedbed preparation, watering, and fertilization. Results of the trials conducted at the station were disseminated to the people inside and outside the project area through demonstrations, exhibitions and videotapes. The project's extension unit of the project played a vital role in this activity. However, the evaluation mission noted that, however, the station was typically underutilized. That is, there was little activity during the summer months due to higher evaporation rates (high water demand by crops) and the spread of summer pests. However, use of mulch material to reduce evaporation losses and activation of pest control programs could have contributed to enhancing station productivity.

3.4 Five women's irrigated gardens established with 5 new shallow wells, and operational.

a) One of the main characteristics of the project is the "buy-in" obtained from village communities for certain project activities that exceeded expectations. Activities designed under this output revolved around providing hand-dug wells, together with technical and financial assistance, to several women groups (8-10 women in each group) in each of the five Village Councils. The purpose of this activity was to diversity the local production system through the irrigated cultivation of vegetables, fodder, fruit trees, or other plants that could serve to ease pressures to extend cultivation on rain fed, marginal lands. These gardens were also designed an income-generating activity.

b) At the conclusion of the project, a total of 17 irrigated vegetable production gardens (or "Jubraka" in the vernacular) had been established, one for each of the project villages, on land set aside and coordinated through the Tanfeez committees (which eventually became the VDCs) within each village council and in close collaboration with the local native administration which has a decisive role in regulating issues related to land utilization. Positive experience by early village adopters (i.e., during 1995 and 1996) was sufficiently persuasive to the rest of the villages. Eleven of these irrigated gardens use hand pumps, with the balance using diesel pumps. Women's groups were consistently active in the production of vegetables that had high nutritional value, low water consumption rates, and for which a local market existed. While the project supplied seeds and seedlings on the basis of a revolving fund, this service became unnecessary after the first several planting seasons, an indication that this activity has good potentials for being sustained apart from project support. Yields were used to satisfy household demand, with any surplus typically sold to nearby, non-project villages.

c) The viability of the vegetable production businesses suggests that the project's identification of women as a target group was strategic in the development of a source of income and improvement in household nutritional status. Given the high level of coordination apparent several months after project termination, there is strong evidence to suggest that the "jubraka" represent a self-sustaining business activity that will help to reduce risks, augment productivity and income, and diversify local revenue base without further drain of natural resources. In the future, targeted support will likely be needed to ensure that steady supplies of inputs are available (e.g., diesel fuel) and women remain fully involved in these vegetable production businesses.

3.5 Five pastoral women's groups assisted in goat production, sheep fattening, dairy production and marketing.

a) The project document envisioned this output to be achieved through mobilization of women's groups through capacity building and access to local markets. By the end of the project, a total of seven women groups had been established. Each of these groups had been set up with a revolving fund to finance investments in cottage industries. Thirty female facilitators were trained in issues such as range management, cheese making, poultry raising, molasses cubes production and wool weaving. Success, as measured by the level of market activity, varied significantly from group to group. On balance, however, at least one productive activity envisioned by this output had taken hold in each of the women's groups. To build on the success of the effort, it would be advisable to introduce additional capacity building efforts (e.g., further development technical and organizational skills, facilitated linkage with the local banks). Such action would help to transform these fledgling businesses into enterprises managed to sustain growth.

3.6 Fifteen community animal health workers (CAHW) trained and operational in the project area.

b) This was another project output that, at least in some respects, exceeded expectations set forth in the project document. Altogether, 41 CAHWs (or paravets as termed by project staff) were trained over a 3-year period starting in 1997, or 11 more paravets than originally planned. Training consisted of poultry diseases/management, vaccination/drug treatment, and diagnosis techniques. Unfortunately, the training was considered of such high relevance and value that the many left the project area for employment using their new veterinary skills in other parts of Kordofan.

3.7 Trials with fodder conservation technologies conducted, and successful results demonstrated to local people.

c) Trials of various fodder conservation techniques centered on several activities. These included hay -making during the rainy season (during which there was an adequate supply of forage available), silage-making to preserve forage green with high nutritive value, and treatment of crop residues and by products.[23] The quality of forage after treatment were analyzed with the assistance of the Agricultural Research Corporation in El Obeid. Results were disseminated during training seminars led by project staff to selected individuals, who in turn spread the message to the rest of the community. There appeared to be reasonably good arrangements and overall coordination between project staff and the testing facility in El Obeid.

d) Several fodder technologies deserve particular mention because of their successful integration in local village economies. First, the production of Guar, leguminous-rich protein forage, to assist in sheep fattening and milking herds was introduced with surprising success as a fodder conservation technology. Its introduction was not anticipated in the original project design but project staff aggressively explored its potential since the Sudanese Guar Company

[23] Treatments were accomplished with molasses, urea, lime and salt at a ratio of 40, 2, 3, and 5% respectively to upgrade the nutritive value and increase palatability and digestibility of crop residues.

had agreed to provide villagers with guar seeds. A total of 19,032 kantars of Guar valued at nearly 4 million Sudanese pounds were produced during the second quarter of 2000.

e) Second, several villages during 1999 were able to produce a total of 1,800 molasses cubes as a result of project training activities. The cost of the inputs was paid through the revolving fund of the respective villages. The molasses cubes were then sold to herders at a minimal price increase. During the last year of the project, a total of 2,400 molasses/urea cubes were produced.

f) Third, the collection of mosquite pods for fattening sheep and milking herds was also practiced with some success together with the use of kitchen wastes for poultry production. Major obstacles to continued success were the weak purchases of dry hay, which is funded by the revolving fund, when there is plenty of forage available in the natural ranges. However, this need not be considered a liability since harvested bales were intended to be used when natural forage supplies are scarce (i.e., as in drought years). The challenge for the project staff concerned storage of the dry hay since it might present a fire hazard if kept in an open area.

3.8 Alternative energy trials and extension.

a) This outputs focused on the introduction of improved cookstoves among the project villages. Prior to this intervention, women typically used either a square metal cookstove or a 3-stone open stove. A training program was conducted on the production of the improved clay stoves that included fabrication demonstrations and instruction on proper use. There is a very high adoption rate among women. At several villages, group interviews among village women confirmed that virtually all households were using them. The range at which firewood consumption was reduced relative to the inefficient metal stoves varied between 33% and 50%.

b) The carbon-monitoring program attempted to verify the direct sequestration levels attained by this output by calculating the equivalent amount of firewood that is not combusted due to improved cookstove efficiency. Based on household penetration (97%), efficiency improvement (i.e., 50%), and the average daily consumption (i.e., 16.2 kg), the total amount of carbon left unharvested and therefore uncombusted was equal to 1,468 tC. When averaged over the entire land area controlled by the 5 Village Councils, the average "carbon savings density" from the dissemination and use of improved cookstoves is estimated as 0.06 tC/ha.

3.9 A development monitoring and evaluation unit established, made up of representatives of relevant sub-committees and committees, and project staff.

a) The project document envisaged that the development M&E unit would monitor the economic and social aspects of project interventions both in terms of development and drought contingency measures. Particular attention was to be paid to whether the activities were successful in increasing the standard of living of villages who adopted project interventions. As with the environmental M&E unit, the community M&E unit was not established until 1998, well after its originally intended start-up date. Nevertheless, the community M&E unit was instrumental in providing inputs to the overall project in terms of providing information on the animal census and socioeconomic information needed for the PPERs. The composition of the unit was 8 project staff and 7 villagers, which was a satisfactory mix for promoting exchange of ideas and methods. A single training event was held in early 1999 to review the evaluation framework for the drought contingency plan that had been prepared a few months earlier.

However, there was no evidence that the evaluation team could assemble regarding the outputs or effectiveness of the monitoring framework that was subsequently implemented.

4.1 A drought subcommittee created within the Legnat al Tansigh.

115. Four activities were identified in the project document to achieve this output, namely establish a drought sub-committee of suitable size and gender composition, formulate a drought contingency plan for the project area, and articulate the committee's mandate, roles and linkages. The committee was set up in 1997.

116. The committees, one in each of the 17 villages, were the focal point for a revolving fund for starting up disaster-resistant income generation businesses and enterprise diversification. The intent of these funds was to provide a way to "shock-proof" vulnerable households and enable them to restart productive activities.

117. A national consultant developed the drought contingency plan in December 1998, quite close to the scheduled end of the project. The formulation of the disaster contingency plan involved capacity building to help deal with drought-associated crises. There is sufficient evidence to suggest that the formulation of this plan was conducted in a participatory manner. The fact that it builds on existing knowledge and codifies decades-old practices is an important factor in this respect. Specifically, the project has made progress in this area through:

a) Establishing a framework, both community-managed and credit based, for a local food security apparatus. This involved stockpiling grain to enable local communities to hold out for thirty days before emergency supplies arrive. Three storage facilities were constructed with a storage capacity of 139 tons of grain each.

b) Implementing some ventures oriented towards bridging the seasonal animal feed gap (March-July) through the production of green fodder and the dissemination of appropriate production techniques.

c) Training of credit sub-committees in early warning system management and improving preparedness for emergency (monitoring rain-fall, pest as well as livestock and crop market trends)

118. These drought contingency arrangements that have been put in place have the potential to protect people's livelihood in the face of a drought. Ideally, such a program could work in tandem with parallel government efforts for the protection of vulnerable populations. Such a strategy could help to protect against risks in advance of a drought, and manage economic afterwards. However, the evaluation team did not find sufficient evidence that such parallel efforts were in place.

4.2 and 4.3: Two credit sub-committees created and operational, one for women and one for men. Two small revolving funds established and operational to provide cash credit to suitable applicants (individual or groups) to finance income generating activities, with emphasis on activities that add value to livestock, such as lamb fattening, handicrafts with hides, milk marketing, cheese production, etc.

119. Because of their relationship to each other, these outputs have been combined. Revolving fund activities were designed to focus on the promotion of two community-based micro credit institutions, and the development of arrangements for credit fund operation and management.

This latter activity was meant to include loan processing and delivery mechanisms, developing linkages with the Agricultural Bank Of Sudan, and helping to build repayment discipline. Due to modifications introduced in the institutional set-up, there were 17 community-based revolving loan funds established, rather the original design for two. It was thought that the establishment of an autonomous revolving loan fund for each VDC would be more effective, and given the greater potential for close coordination due to the existence of other ongoing project activities, this appears to be a reasonable strategy. Members of the credit sub-committees received training in credit fund management, simple bookkeeping and clerical work. The level and quality of account bookkeeping and clerical work system varies significantly from one VDC to another though in general, the evaluation team considered it adequate.

120. The total loan portfolio in the first cycle of the revolving funds was Ls. 121,427,648 for the direct economic benefit of 3,820 replicated beneficiaries. The figure of 121 million Ls represents the monetary value of all the credit-based inputs extended by the project to the concerned communities since its inception. This figure also includes the 17 irrigation facilities. The term "first cycle" indicates the phase in the revolving credit fund in which the different resources are passed by the project to the communities as seed capital to be repaid and then re-invested in the subsequent cycles of the revolving fund. No data is available to show how these revolving funds have revolved or to show if there is any tendency for capital growth or financial resource regeneration. It is important to note that the revolving fund component of the project was established in the context of two slow-onset disasters, namely recurrent drought and acute food shortages. Confronted with this persistent disaster context, the revolving funds component was clearly effective with its limited funding level in meeting a near-term disaster-mitigation/management need.

121. The overall repayment percentage was 62%. Given the region's fragile economy (characterized by high risk, widespread vulnerability, poor resource endowment, and low income), this percentage appears to be reasonable in the opinion of the evaluators. It is noteworthy that the two banks that are operational in the area do no t have average loan collection rates of more than 45%, even though they enjoy legal enforcement options. Within the project villages, and during natural disasters, repayment holidays are normally agreed upon between VDCs and households for all or some of the credit inputs with re-pricing and conversion of annuities into commodities.

122. Within the project villages, training was provided to help the members of the VDCs become acquainted with techniques of loan repayment in order to cope with inflation. These included a) conducting loan transactions in kind and keeping repayment in cash to the minimum; b) diversifying investment mechanisms and sectors as a risk hedging practice, and c) promoting the delivery of credit based on a realistic economic price to avoid the erosion of the revolving credit fund.

123. At the village level, no autonomous or separate credit sub-committees for both men and women have been established. This was due to the fact that targeting the household as an economic unit was more feasible than targeting individual men or women. Also, the high illiteracy rates and certain cultural barriers put limitations on the capacity of women to run independent credit institution effectively at this stage.

124. It's fair to conclude that the revolving funds component has generally been working well alongside the rest of the project components within a project approach. Table 5 summarizes the

evaluation of how major policy issues have been built into the revolving funds mechanism through planning, training, consensus building and awareness-building.

4.4 A livestock restocking program established and operational, with capacity to restock the herds of up to 80% of the poorer project population whose herds have lost reproductive potential, but done gradually so as to keep apace with the rehabilitation of rangelands, water development, and the fodder production activities, in order to prevent overgrazing.

125. This output has been revised substantially. Instead of a herd-restocking program, a replacement program of sheep for 80% of the goat population was implemented. The purpose of this change was to cull the livestock herds of goats, which have destructive grazing patterns and replace them with sheep, whose grazing patterns are far more benign. Furthermore, sheep are able to fetch a greater market price. The restocking schedule was implemented over a period of three years between 1997 and 2000. By the end of the project, 2,405 goats had been replaced with 481 sheep. There appears to have been strong effort and relatively good progress in working with poor families who had lost their much of their herds during past droughts.

126. This change represented a major improvement in project design and in the view of the evaluation team that enhances the potential for long-term sustainability. However, certain precautions and further modifications are necessary to ensure sustainability. That is to say if 100% replacement took place, certain plant species which are less palatable to sheep, will likely dominate rangelands at the expense of palatable species to sheep. Site inspections confirmed that this was already taking place. One potentially viable response in the next few years could be the reintroduction of cattle in the area at a slow rate. It was noticed by the mission that certain species, which are palatable to cattle but less palatable to goats and sheep, are flourishing and might be a problem in the near future if cattle were not reintroduced.

4.5 A grain storage and credit program (for seed not relief aid) established and operational, and giving grain credit to a maximum of 80% of the project population.

127. The project document lists several activities for this output, including the establishment of 5 grain credit funds (one for each Village Council), provision of seed capital in the form of grain stocks, and the establishment of a drought early warning system.

Table 5: Summary of issues and rating of the revolving fund system

Issue	Description	Rating
Access	Enabling the most vulnerable segments of the target communities to gain access to credit-based production resources and thereby have options for productive activities	Good
Utilization	Enabling the target communities to attain efficient utilization of funds for the household as an economic unit	Good
Repayment	Promoting disciplined repayment and avoid misallocation of scarce funds and to ensure continued operation of the credit fund	Poor
Cost	Ensuring that the village-based revolving loan fund limits its costs and risks so that its existence and independence are not endangered	Good
Transparency	Promoting a "democratic" form of financial resource management that minimizes risks that the poor are disadvantaged by VDCs or other influential persons and institutions	Good
Eligibility	Establishing sound eligibility criteria that discourages extension of credit to anybody who applies (i.e., "credit for anybody and everybody")	Good
Control	Promotion of community control of village investment resources in the sense that eligible individuals have equal access to them while resource utilization remain a shared responsibility, with decision-making power centered in the community	Good
Management	Ensuring participatory planning regarding resource allocation policies as well as the management of the credit fund	Good
Internal risk	Providing types of loans, their volume and terms that correspond to the needs of the borrowers as well as repayment capacity to avoid a situation of credit-induced poverty	Good
Flexibility	Providing loans to the vulnerable segments of society through mechanisms that are adjustable to local conditions and are culturally and organizationally acceptable	Excel-lent
Impact	Establishing a credit system that helps provide broad loan service coverage with special emphasis on reaching the most vulnerable segments, particularly women	Good
Institutional viability	Establishing a critical mass of these resources in order to create a situation in which the incentive for institutional development is strong	Good

127. Throughout the project's life, 3 appropriate storage facilities have been established with a total storage capacity of 139 tons of grains. The construction plan was changed from emphasis on local materials to more reliable non-local materials that better protect against the hazards of fires, rain, and pests. At present, these storage facilities remain underutilized and are used for the safe-keep of some grains and cash crops owned by the VDCs. Under any extension arrangements, efforts should be exerted to tap the full potential of these storage facilities as an integral part of any effective drought-contingency strategy

128. The World Food Programme (WFP) wasn't able to meet the grain inflow target of 12,000 sacks (US$ 240,000) as specified in the original plan. It's apparent that even 50% of this capital grant assistance could have enabled the project to accelerate the process of promoting a full-fledged credit-based food security and risk-management strategy provided that an early warning system, vulnerability assessments and portfolio protection measures are in place.

129. There was evidence that communities had increased in awareness and understanding of forage storage as a drought contingency measure. In addition, they secured food for the community by building a grain store for relief aid and a credit program. In 1999, 171 sacks of millet and 25 kantars of sesame and in year 2000, 250 sacks of sesame and 35 sacks of millet were stored in 3 of the 17 project villages for this purpose. It seems like providing storage facilities for dried hay and preserved forages to be used off season should be given a high priority in future plans since it will ease pressure on grass lands during summer time.

D. Immediate Objectives

1. *An enhanced capability of the local people to manage their natural resources on an effective and sustainable level in order to prevent land degradation and to improve or rehabilitate rangelands, in order to contribute to a reduction in global warming through enhanced carbon sequestration, and to increase an increase in global biodiversity.*

a) The formation of Village Development Councils, the establishment of village-level mobilization units, the numerous training events programs that were held in the various villages, and the ongoing extension services, contributed to raising a high level of awareness among the project villages about the link between rangeland rehabilitation and sustainable rural livelihoods. There is strong evidence, obtained through structured interviews and by direct observation, that management strategies espoused by the project were clearly understood and were being honored. Some villages had even taken the further step of introducing certain equity modalities in order to provide support for the neediest households in their village within the overall framework of the new rangeland management strategy.

b) It was clear that the utilization of project resources to carry out the various interventions in support of the new rangeland management strategies was effective in both transferring local knowledge and strengthening the shift away from traditional risk hedging strategies that had led to land degradation. The high degree to which this objective was achieved is a strong indicator of the appropriateness of the participatory planning model introduced by the project.

1. *An enhanced ecological capacity for rangeland regeneration after drought, and initiation of the rehabilitation of a portion of the degraded areas, through physical interventions and people's participation, with a view to testing and demonstrating technologies and organization frameworks that could be replication by the people.*

c) In spite of the delay in the implementation of range rehabilitation activities, this objective has – to an important degree -- exceeded initial targets set forth in the project document. Rather than 100 hectares of rangeland improved and properly managed, the project can take credit for the enhanced ecological capacity of 700 hectares. Notably, the additional 600 hectares was improved on the basis of voluntary communal decisions that were made after being collectively persuaded of the benefits of such action. In addition, individual households set aside about 500 hectares of private cultivated land for conversion to rangelands. This represented an enhancement in

ecological capacity that had not been foreseen in the objective as originally conceived. It also coincided well with the overall aim of the project to reduce the extent to which marginal lands are cultivated for agricultural purposes.

d) The project was less successful in certain other activities. Regarding the establishment of windbreaks, only 55% of the initial target was achieved. Regarding sand dune revegetation, the total areas revegetated exceeded initial targets. However, the change in configuration (i.e., square rather than rectangular) will likely limit the extent of long-term benefits than can be achieved from this intervention. Finally, the monitoring and evaluation system, particularly regarding the verification of actual levels of carbon sequestered by the above activities, was not sufficiently rigorous.

1. *An improved basis for and diversification of the local production system through improvement of basic inputs, and introduction of appropriate environmental education and technological innovations.*

e) Diversification of the local production system was accomp0lished by a broad set of community development activities, characterized by active involvement of both the local village populations and project staff. Each of the activities (i.e., water development, experimental nursery station, women's irrigated gardens, sheep fattening, dairy production, macaroni making, paravet activities) undertaken were, to varying degrees of success, continuing at the time of the evaluation mission despite the end of the project and the termination of project assistance. The evaluation mission believes that these productive activities and technological innovations are well integrated into local networks and the population is fully capable to continue development activities into the future.

1. *Drought contingency measures set in place to reduce the adverse effects of droughts and assist the local people to revitalize their household economy.*

f) This objective calls for the development and implementation of drought contingency measures with the intent to assist villages to both mitigate the adverse effects of drought and enhance the socioeconomic profile of households. The various activities regarding committee formation, training, and developing a drought contingency plan, as indicated in the project document, were carried out. However, unlike other objectives there is insufficient evidence that a shift in villager perception had taken place. Staple storage in the three silos was far below capacity. The early warning system called for in the contingency plan appears to have been followed on an ad hoc basis by the time of the evaluation mission. For these reasons, the evaluation team considers that this objective regarding drought preparedness was not fully achieved.

E. Development Objectives

1. *An effective, appropriate and sustainable natural resource management system at the local level that would prevent over-exploitation and degradation, and would rehabilitate and/or improve rangelands, in order to contribute to the reduction of global warming through carbon sequestration, preservation of biodiversity, and reduction of atmospheric dust in the region.*

2. Local knowledge and awareness about the principles of range management have been significantly enhanced. Project village development committees have adopted a rotational grazing system, and have constructed fire lines as a safe guard against wild fire. These are the basic principles in range improvement and management, both in communal and private grazing allotments, and their widespread adoption in the project area suggests that the communities have begun a transition to a more sustainable resource management system.

3. Moreover, these basic principles of range management are very effective in restoring vigor and maintaining range biomass resources in good condition that will promote their survival. Livestock herders have learned how to determine the carrying capacity of their rangelands and this has begun to have an impact on stocking rates. The ultimate outcome of these measures is the reduction of grazing pressure on rangelands, thereby helping to restore plant cover to protect erosion-prone soil and enhance carbon sequestration. Moreover, the understanding of the community to shift from cultivation to grazing in such fragile environment is a major step towards reversing land degradation trends.

4. Reduced risks of production failure and increased number of alternatives for sustainable production strategies from which people can choose, eventually leading to a reduction in reasons for out-migration and population instability.

a) This development objective relates largely to the transition to more sustainable land use management strategies. The potential exists for the VDCs, even with their modest resources, to play an enabling role in mobilizing local resources to mitigate the potential impacts of production failure. The key is the VDCs capability to provide the coordination necessary to combine local resources and energy with resources represented by government agencies. Neither set of resources appears to be adequate on its own to have a lasting impact of reduction of out-migration. However, the resources of government, is capably directed at local projects, combined with the human and financial resources of local communities, if properly trained and motivated, are together capable of significantly affecting population instability.

F. Effectiveness

a) Through community mobilization, consensus building and awareness building, the project had managed to emphasize the comprehensive nature and scope of these rehabilitation initiatives. In the view of the evaluation team, animating much of the project's activities were several fundamental questions – what incentives will be required to motivate households to get involved and stay involved in carbon sequestration? what issues need to be addressed to ensure carbon storage outcomes are positive for households? and what additional support will be necessary to ensure a workable and sustainable system well into the future?

b) Addressing these questions was manifested by taking the capacities of the concerned communities into account at an early stage and advocating a model of partnership with these communities. Promoting the interest of the local people, as well as their capacity to be engaged in utilizing the full environmental, economic and social opportunity cost of these assets, was conducted in a manner that was both efficient and effective. The participatory approach added credibility to project interventions. The process of villagers talking to villagers has developed a support groups network that contributed to the increased rate of adoption of new land management techniques that were introduced.

c) At the point of inception, the project could have set a clear strategy and operational policies that give women more access to and control over these asset-based means of production. This could have been implemented by better addressing issues of gender sensitization. Such an affirmative action measure could have had a better impact on women's livelihood than some cottage industries promoted by the project. These industries are continuously faced with problems such as lack of raw materials and poor product quality. To varying degrees, they also are faced with competition with established markets already providing the good or service.

d) It's evident that the high implementation cost of some of the investments (e.g., diesel pumps) will likely continue to fall beyond the direct and immediate repayment capacity of the concerned communities. This, however, should not be a major detriment of the effectiveness of the project worry because a detailed financial and economic appraisal would indicate that these ventures could be managed as asset-based financial resource regeneration mechanism provided that the institutional/community framework as developed by the project continues to be effective. Also, the use of diesel pumps was highly contradictory to the aims of carbon sequestration. Assuming the 6 diesel pumps use an average of 8 liters per day throughout the year, total carbon emissions come to about 12 tC per year, or 240 tC over a 20-year period.

e) In spite of the relative progress that has been attained using the community mobilization approach, it's apparent that the challenges facing communities are still massive regarding rebuild/reform local institutions to help replace lost/disrupted physical and social capital. The mission feels that extra innovative efforts are still needed to assist local communities, as well as to strengthen new institutions to extend the process of environmental and socio-economic rehabilitation confidently into the future.

G. Capacity Building

a) A review of the relevant project reports as well as interviews with the concerned project personnel reveals that over 2,400 people representing the different community institutions participated in the different training events. The mix was 41.8% male and 58.1% female. In addition, project staff participated in a total of 64 staff-events organized within the Sudan and abroad.

b) Training activities have helped a majority of the local community to realize that by organizing themselves around certain new innovative practices, quality of life can be enhanced. There is sufficient evidence to indicate that the project is well aware that drought-induced poverty is linked with virtually all other issues of human well-being as both cause and effect. Accordingly, the project management was quite successful in incorporating the range of local stakeholders within a broad-based framework of co-ordination and collaboration. Within this framework, emphasis has been laid on establishing proper relations with all these players as well as working in partnership with them through information sharing, joint planning and the rational use of resources. Cases of co-operation and collaboration with the North Kordofan Area Development Scheme, the Sudanese-Swedish Friendship Association and the local tribal/political leadership are a few noteworthy examples.

H. Impact

147. Moving from conventional practices to a lower disturbance system that emphasized rangeland preservation required major changes in local practices. Ultimately, the proof of the

impact of such a project is that its outcomes are of sufficient appeal to a range of stakeholders to offer good potential to be a model/catalyst for other areas. To this end, the following are important impacts deserving mention:

a) Conversion of marginal lands: Private households were sufficiently convinced of the potential benefits of rangeland management techniques to convert 500 ha of marginal private lands used for cultivation to private rangelands.

b) Institutional organization: The communities were very receptive to being organized into a set of implementation committees and subcommittees to carry out project interventions. Local networks localized at the village level rather than the Village Council level worked best.

c) Participation: The range of project activities including rangeland seeding/planting, maintenance of women's gardens, monitoring the revolving funds, etc were carried out by properly trained local individuals. There is a clear sense of "ownership" for most project interventions.

d) Drought contingency planning: Despite the fact that the communities had taken strong steps toward a transition to livestock-raising focus and away from extending cultivation onto marginal lands, a risk-hedging strategy against drought still includes cultivation on marginal lands. That is, approximately 550 ha of degraded lands had been converted to agricultural use.

I. Sustainability

147. International assistance to the project was essentially terminated about one year prior to the evaluation mission and activities have continued unabated. In particular, the village committees seem to be well established units within the overall communities.

148. Government funding in support of project activities has been modest, and was evident only toward the end of the project when some cost-sharing took place. The project seems to have been unaffected by fluctuations and developments in the national Sudanese economy.

149. In the view of the evaluation team, the project villages are well equipped with the knowledge, innovations (e.g., seeds), and trained personnel for continued activity to promote the development objectives of the project. The quality of trained local committee members is quite adequate and they are capable of sustaining project activities into the future. The fact that many project activities were active at the time of the evaluation mission, and were being administered by local villagers in the absence of the project staff, is a good indication of the relevance and sustainability of the overall effort.

J. Follow-up

151. In the view of the evaluation team, two major areas of follow-up have emerged. First, conclusions related to the level of carbon sequestered by project activities need to be firmed up. Despite the many successes of the project, gaps exist in the verification of the relationship between projects activities and carbon sequestration levels. For this reason, carbon-monitoring activities should be extended for a reasonable period of time, say for another three to five years. A carbon monitoring protocol that includes soil organic carbon should be established and carefully vetted with international experts. Such a program should be linked to the collection of a range of other relevant data on rainfall, temperature, and socioeconomic conditions in order to establish the effect of a range of pertinent factors on carbon storage rates.

152. Second, the appeal of carbon sequestration in semi-arid areas in Sudan lies in its spatial potential rather than its carbon intensity per unit of land area. That is, even though carbon sequestration levels are low in semi-arid rangelands in Sudan (i.e., between 2 and 5 tC/ha) compared to tropical forests, potential carbon storage levels could be very large given the enormous rural land resources available. Investors under some future CDM regime (or other such flexibility mechanism to be developed) may consider investments in Sudan attractive if they can be persuaded that the vast spatial potential is not only accessible but amenable to alternative, long-term, and verifiable rangeland management strategies. For this reason, extending the participatory model developed at Gireigikh to a much larger scale, say in at least 1,000 additional contiguous Rural Councils in Kordofan State, would be highly desirable. Such a project can be justified under Operational Program #12, Integrated Ecosystem Management. Outputs of such a project would help to validate that the model is workable at the larger scale needed to attract international climate project investments.

VIII. Conclusions

153. The most pressing conclusion emerging from this evaluation is that the project strategy to rehabilitate and improve marginal lands has demonstrated the potential to enhance carbon sequestration. This has been evident as a result of the project's successful combination of the following elements:

a) Participatory planning.

b) Introduction of relevant innovations and strategies.

c) Capacity building.

d) Access to credit for productive activities.

154. Ultimately, the proof of the impact of such a project is that its outcomes are of sufficient appeal to the range of stakeholders to offer good potential to be a model/catalyst for other areas. Within the project area, several major objectives exceeded original targets project due to perceived benefits. Outside the project area, there is evidence of positive leakage as several villages that have not been involved in the project have, by virtue of accepting the premises of the intervention through contact with project villagers, begun to implement some of the project strategies.

155. The project has performed very well at most levels over its final three years. Despite a bad early start, a period in which certain project objectives were misinterpreted and schedule milestones were not kept, the project rebounded well enough to achieve its core activities. A dedicated and creative project staff, led by an effective national project director, combined to create a positive working environment. Together with an evident keen interest on the part of the UNDP Country Office, the project was a strong and effective performer in its latter stages.

156. In the view of the evaluation team, the project villages are well equipped with the knowledge, innovations, and trained personnel for continued activity to promote the development objectives of the project. The quality of trained local committee members is quite adequate and they are capable of sustaining project activities into the future. The fact that many project activities were active at the time of the evaluation mission, and were being administered by local villagers in the absence of the project staff, is a good indication of the relevance and sustainability of the overall effort.

A. Findings

160. There has been a high level of awareness built up by the project regarding principles of rangeland rehabilitation and management. Villagers appear convinced that the unsustainable removal of biomass is harmful to their livelihoods. However, villagers have not bought-in completely to the principles advocated by the project as risk-hedging strategies involving expansion of cultivated lands continues at roughly the same rate as the expansion of conversion of fallow land to rangeland.

161. Villagers proved to be highly responsive to the training and methods used to introduce new natural resource management techniques and technological innovations. This includes the following:

a) Integration of the nomadic tribes into the overall fabric of the project. Transhumants participated in the committees and training activities, as well as sharing in appropriate near-term benefits (i.e., sheep restocking),

b) Introduction of improved cookstoves. In each of the project villeages, the penetration rate of these commercially available stoves exceeded 90%,

c) Integration of the revolving fund concept among the villages. At the time of the terminal evaluation, there was evidence of both self-discipline in loan repayment and fund management - this despite the project being essentially over for about one year.

d) Adoption of a rotational grazing system, and the use of fire lines as a safe guard against wild fire. These are basic principles in proper range improvement and management, both in communal and private grazing allotments.

159. In promoting these changes, the community-based approach was particularly effective to the degree that it focused on homogeneous social units. The more nuclear the group, the more effective the results. There is also evidence that positive leakage is occurring in the region as several village communities that had not participated in the project have begun to implement some of the project activities (e.g., cookstoves, and rangeland rotation strategies)

160. The project was able to effectively adapt to on-the-ground realities. Several elements of the project document were redesigned in light of better information that had been acquired at the site. An example of this is the focus on the village development committees, rather than the village council committees. Another example is the restocking of herds with sheep instead of goats. Indeed, the herd replacement appears to be working effectively from an ecological and economic perspective. The project's upper limit of 80% replacement by sheep is valid in view of the fact that a higher number could alter the rangeland species balance and lead to an inadvertent domination of certain species over others to the detriment of livestock herds

161. The evident flexibility of project implementation was particularly important given that the start-up of the project over the first two years proved to be ineffective. The project had begun to proceed in directions counter to those outlined in the project document and detrimental to its ability to meet its multiple objectives. This made it necessary for project activities to be squeezed into a shorter period of time. However, the project appears to have recovered fully from this disadvantaged start.

162. A weak aspect of the project was the validation of the amounts of carbon actually sequestered. There are several reasons that have been outlined in the previous discussion. There

is insufficient evidence, at the present time, to quantify with confidence the linkage between the supportive development activities and actual levels of carbon sequestered.

163. The role of the different government entities in advocacy and creating a supportive environment for the project was less than ideal. It's advisable that any future initiative should include a detailed qualitative and quantitative description of the inputs, roles and responsibilities of each stakeholder within a well-defined partnership framework. The evaluation team feels that the government should have utilized the full opportunity cost of this project by integrating its modality and skills in a wider approach of environmental and socio-economic recovery in the wake of droughts. State government agencies should have been more involved throughout the project. Aside from a cash infusion towards the end of project activities, the contribution of knowledge and resources was negligible. A stronger involvement could have posed benefits in the transition after project completion.

164. Hence, these findings suggest that reducing pressures to expand agricultural cultivation can be accomplished with the model adopted in this pilot project. The evaluation team finds that approach to integrating pastro-nomadic communities into the Giraigikh rangeland re-habilitation initiative to address issues of capacity building, pastoral needs and priorities should be appreciated. The consolidation of this approach could help integrate pastoralists further in the mainstream rangeland rehabilitation process and help to strengthen social institutions and mitigate marginalization through a long-term process of local empowerment.

IX. Recommendations

165. Carbon-monitoring activities should be extended at the project site for a reasonable period of time, say for another three to five years. A carbon monitoring protocol that includes soil organic carbon should be established and carefully vetted with international experts. Such a program should be linked to the collection of a range of other relevant data on rainfall, temperature, and socioeconomic conditions in order to establish the effect of a range of pertinent factors on carbon storage rates.

166. Certain activities were more effective than anticipated, especially the setting aside of private cultivated lands for pastoral grazing, organization of villages into development committees and subcommittees, and the introduction of improved cookstoves. Efforts should be made to incorporate the approaches used in the implementation protocols for other projects.

167. A follow-up project that extends the participatory model developed at Gireigikh to a much larger scale, say in at least 1,000 additional contiguous Rural Councils in Kordofan State, would be highly desirable. Outputs of such a project would help to validate that the model is workable at the larger scale needed to attract international climate project investments.

168. A study should be commissioned that examines the costs and benefits of a gradual reintroduction of cattle to the region. Such a strategy could obviate the mono-cultural species tendency in fields that have been converted to pastoral lands.

169. The equipment and facilities should be kept intact until final resolution of possible follow-up activities at the project site and surrounding regions. Steps should be taken to ensure a more active government involvement and support to local-level planning in the future.

X. Lessons Learned

The whole of the Giraigkh initiative is an investment in people through technical and institutional assistance, loans and policy support. Within this framework, the various project elements were instruments for simultaneously enhancing carbon sequestration while closing the gap of finance in the rural economy by providing investment resources to the communities.

The key lesson that has emerged from this plot effort is the role of public ownership as a major factor of success. Not the project staff, government agencies, or the Agricultural Bank of Sudan had (or has) any direct management responsibility over the resources provided to the Gireigikh RC. Yet, it was evident that a high degree autonomous self-monitoring was taking place. For this reason, any future effort to sequester carbon in semi-arid areas of Sudan should carefully consider applying the broad principles embedded in the project design, suitably adapted to reflect other local contexts. As a corollary, another lesson is the importance of encouraging the engagement of private assets. This was a notable though unanticipated direction of the project as private grazing allotments became a locally driven development.

XI. Annex 1: Terms of Reference for Project Terminal Evaluation: SUD/93/G31 (SUD/96/017) – Community Based Range Lands: Rehabilitation for Carbon Sequestration and Biodiversity

Introduction:

The Community Based Rangeland Rehabiltation Project (CBRRP) is situated within Gireigikh rural council of Bara Province of North Kordofan State. The CBRRP is a carbon sequestration pilot project, the first of its kind in Sudan. Initial results show that through the project's development and implementation of land use and rangeland management master plans in the project area, carbon sequestered has increased from its estimated present levels of 6 tonnes Carbon per hectare per year to about 10 tonnes Carbon pre hectare per year, or about 240,000 tonnes additional carbon sequestered per year.

The project's overall development objectives were to achieve a sustainable, local-level natural resources management system that that prevents degradation, rehabilitates or improves rangelands, reduces global warming through carbon sequestration, preserves biodiversity, and reduces atmospheric dust in the region. The project has also aimed to reduce the risks of production failure and increase the number of alternatives for sustainable production, so that out-migration will decrease and the population will stabilize. These development objectives follow the Fourth UNDP Country Programme's (1993-1996) three areas of concentration: (i) sustainable rural development, (ii) promotion of food security, and (iii) strengthening of national capacity to manage development.

The project was approved prior to the GEF 1995 Operational Programmes being formulated and prior to the incremental cost consideration coming into force. The project was prepared during GEF Pilot Phase at a time when carbon sequestration was considered a possible venue for GEF programming. As the information, data and studies on carbon sequestration in the dry lands is very poor UNDP set out to work on this and a sister project in Benin to (a) gather data about the extent of carbon sequestration in the dry lands and (b) to test the hypothesis about carbon sequestration in the dry lands.

The key stakeholders of the project are the community of Gereigikh Rural Council, Range and Pasture Administration office of North Kordofan State and the Federal Range and Pasture Administration.

Objectives of the Terminal Evaluation:

The evaluation is initiated by the Government and the project management. The evaluation report will help the stakeholders to decide on the future of the project. Amongst the overall evaluation findings, the evaluation will help to identify activities that still need further consolidation, and if an extension of the project is approved this will help the stakeholders to work out a work plan for these activities to be consolidated. The main stakeholders of the evaluation are GEF/UNDP, Government of Sudan (National Execution Management Support Unit, Range and Pasture Administration and Ministry of International Cooperation and Investment), project beneficiaries and project staff.

Scope of the Evaluation:

This is a natural resource management project and is implemented mostly by the project beneficiaries. The project is working in 17 villages within Gereigikh Rural Council of Bara Province, North Kordofan State. While most of the project activities are confined to these villages, few of the activities were conducted in villages not far from the project area, and other activities (grazing allotments) are near these villages. Government offices to be visited during the evaluation are located at Bara town and El-Obeid. The project duration is 5 years and it started in July 1995. The scope of the issues to be addressed in the terminal evaluation are as follows:

A) Undertake a detailed review of project results relative to project objectives. Key issues to address are:

   1. Have the objectives of the project being achieved?
   2. Have they been achieved to a satisfactory level?
   3. Are community organizations working successfully?
   4. Describe the composition of the community organizations (and especially gender composition), regularity of community activities; and documentation.

A) Undertake a detailed review of training programmes implemented: Key issues to address are:

   1. What types of training were offered to the beneficiaries and the project staff?
   2. What was the frequency of training?
   3. Was training properly budgeted?
   4. Describe the composition of trainees (with special attention to gender).

A) Undertake a detailed review of the outcomes of the project. This component of the evaluation should address actual outcomes (intended and unintended) and to assess whether the side effects are adverse or salutory.

B) Undertake a detailed review of the impact of the project on the environment.

C) Review the cost-benefit analysis of the project

D) Compare the project approach and results to similar projects that have been implemented

Products expected from the Evaluation:

The evaluation report should contain a section to reflect the effect of improving range lands on the significance of carbon sequestration, and more specifically to evaluate the effect of grazing intensity (heavy, moderate or light) on the level of carbon sequestration.

Tasks

The terminal evaluation team should undertake the following:

A) Participate in briefing sessions at Khartoum with UNDP, Government (NEX-MSU, RPA and MICI) and at El-Obeid (Ministry of Finance and Economic Planning, ADS – El-Obeid project and RPA office).

B) Review the original project document, the TPR reports, the project quarterly progress reports, the 1997 and 1998 PIR (Project Implementation Review) reports and any other technical reports that will provide a clear picture about the project activities and the level of implementation.

C) Interview beneficiaries of the project to assess their level of understanding and their role in implementation of the different project activities. This includes visits to some of the 17 project villages to review on-site activities and achievements.

D) Participate in debriefings at the project level, El-Obeid and Khartoum and prepare a draft terminal evaluation report before the mission ends its assignment in Sudan.

E) Finalize the terminal evaluation report and submit to UNDP.

F) Prepare a draft project brief on a follow-up to the project, if needed.

Composition and responsibilities of the Evaluation team:

The terminal evaluation team leader should be an international consultant. His/her background should be a Climate Change Specialist or a Carbon Sequestration Specialist.

The terminal evaluation team should include:

A) A local rural development specialist (socio-economist). He/she will cover the aspects of community development and should assess the degree of involvement of the community in project implementation and whether the approach followed was the best or not. Provision of credit (revolving fund) to the beneficiaries should also be evaluated by the socio-economist to know how effective this intervention was.

B) A local rangelands management Specialist (fodder production specialist). He/she will assess the intervention of the irrigated fodder production.

C) The NEX-MSU's M&E Officer is to be an ex-officio team member in order to represent the executing agency and to handle the monitoring and evaluation aspects of the project

Implementation Arrangements

The UNDP field office will inform the Government of Sudan of the project evaluation and obtain the government concurrence. Government representatives who will join the evaluation mission will be identified and informed of the mission itinerary. Logistical support will be arranged.

XII. Annex 2: Evaluation Schedule

24 April	Arrival by consultant, Meetings with National Project Director
25 April	Briefing at UNDP Country Office, Review of documents and literature
26 April	Review of documents and literature, Meeting with UNDP Resident Representative, Meeting with other members of the evaluation team
27 April	Review of documents and literature, report writing
28 April	Review of documents and literature, report writing
29 April	Travel to El-Obeid with NPD and M&E officer of NEX-MSU, Stop at the regional office of the RPA, Continue travel to project site at Bara, Upon arrival at project headquarters, meet project staff and local leadership in evening
30 April	Orientation tour of the project site, Visit to Sheikh of Merkeih (rest of the evaluation team arrives in evening), Review of project documentation and reports
1 May	Visit nursery at Giregikh and conduct interviews, Visits to Umm Bugail'a, El Surareeya Mukawi, and Iyal Ali to conduct interviews, Review of project documentation and reports
2 May	Visits to Sarareeya el Daw, Um Dayoga'a El Tilib, Iyal Ali to conduct interviews, Review of project documentation and reports
3 May	Visit to Shiraim El Kuramsh'a to conduct interviews, Meeting with the local commissioner, Review of project documentation and reports
4 May	Depart Bara. Meeting in El Obeid with Dr Suliman Gabir, Director General, State Ministry of Agriculture, Kamal Mahjoub, Director, Agricultural Services, and Tariq Ameen, Office Director, State Ministry of Agriculture, Evening arrival in Khartoum
5 May	Meeting with Mr Abdul Atti Jabir, Assistant Secretary and Deputy Director fo NEX-MSU, Review of documents

	Meeting with Dr. Ali Darag, former Chief National Technical Advisor to the Gireigikh CBRRP
6 May	Meeting with Omar El Goni Senior Range Officer of the RPA (and NPD of the Gireigikh CBRRP in the early years of the project), Mohamed El Amin Abdel Rahman, Director RPA, Hussein Mustapha, Head, Natural Range Section.
	Meeting with the Minister of International Cooperation
7 May	Departure from Khartoum to University of Lund
8 May	Meetings with Drs Lennart Olssen and Andrew Warren concerning the development of a Project Brief for potential follow-up project

XIII. Annex 3: List of Persons Met

UNDP Country Office, Khartoum

Ms. Intisar Salih, Program Officer
Ms., Resident Representative

Ministry of International Cooperation

Dr. Adam Ballouh Mohamed, State Minister, Ministry of International Cooperation
Mr. Abdul Atti Jabir, Assistant Secretary and Deputy Director of NEX-MSU,

Range and Pasture Administration

Mohamed El Amin Abdel Rahman, Director
Omar El Goni Senior Range Officer (and NPD of the Gireigikh CBRRP in the early years of the project),
Hussein Mustapha, Head, Natural Range Section

Bara Project Staff

Dr. Ali Darag Ali, former National Technical Advisor to the Gireigikh CBRRP
Mr. Ahmed Hanafi Abdel-Magid, National Project Manager
Mr. Faisal Hassab Er-Rassoul El-Jack, Senior Range Officer
Mr. Abdel-Rahman Ahmed Khatir, Range Officer

Gireigikh Rural Council

Mr Abu-ElBashir, Sheikh of Merkeih
Members of the Gireigh Rural Council Tansigh Committee
Village Development Committee members and villagers of Um Bugaila'a
Village Development Committee members and villagers of El Surareeya Mukawi
Village Development Committee members and villagers of Iyal Ali
Village Development Committee members and villagers of El Sarareeya El Daw
Village Development Committee members and villagers of Um Dayoga'a El Talib
Village Development Committee members and villagers of Shiraim El Kuramsha'a
Commissioner, Bara Province

Ministry of Agriculture

Dr Suliman Gabir, Director General, State Ministry of Agriculture,
Kamal Mahjoub, Director, Agricultural Services,
Tariq Ameen, Office Director, State Ministry of Agriculture,

University of Lund, Sweden

Dr. Lennart Olssen, Director, Center for Environmental Studies
Dr. Andrew Warren, Visiting Scholar

XIV. Annex 4: Documents Reviewed

Project Document: Community Based Rangeland Rehabilitation for Carbon Sequestration and Biodiversity, August 1994

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The Assessment of Livestock Feed Balance and Carbon Sequestration within the Project Area (Year 1999)

Carbon Sequestration Assessment and Monitoring: Comments on the draft Final Report, by Mr. Ali Darag Ali

Baseline Report, by Mahmoud Mekki and Intisar Abdeslsadig, 1997

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The Case of Community Based Rangeland Rehabilitation Project for Carbon Sequestration in North Kordofan/Sudan

Proposed Workplan for 1997, by Omar Elgoni and Ali Darag, February 1997.