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STRATEGY FOR RESEARCH ON RENEWABLE NATURAL RESOURCES**

NATURAL RESOURCES SYSTEMS PROGRAMME

FINAL TECHNICAL REPORT

DFID Project Number

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Project Title

Human and Social Capital's Role in Natural Resource Management in Tanzania

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NRSP Production System

Semi-Arid Production System

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EXECUTIVE SUMMARY

1.0 Background

The project seeks to understand the interdependence between catchment management practices, human resources, and social (or institutional) capital. Informed by the analysis of factors determining current natural resources management practices, new knowledge on the alignment of costs and benefits with individual and social priorities, are used to assess the feasibility of improved natural resources management strategies, and their likely effect on the poor

2.0 Project Purpose

The project will comprehensively documents current catchment management practices and identifies researchable constraints on the development of new resource management strategies contributing to the wellbeing and livelihoods of the poor.

Stakeholders with interests in livelihoods in semi-arid areas will better understand the contributions of and demands on, human and social capital respectively, to catchment management. This knowledge will advance the development - through policy, research and practice - of new approaches to NR management which benefit the poor.

3.0 Methodology and conceptual framework

Research results from literature and guided field work provided an understanding of the interdependence between catchment practices, human resources, and social (or institutional) capital. A sample survey of 153 and 155 households from two catchments was conducted. Consultations with target institutions and individual key informants supplemented data from literature review and the field survey.

The sustainable livelihoods framework was used as a conceptual tool in understanding the relationship between catchment resources, natural resource management and livelihood assets with special emphasis on human and social capital.

4.0 Project Inputs

This project has contributed to establishment of working relationships between SUA and NRI which were the main research organisations. It also enlisted the participation of other research organisations and projects, governmental departments and non-governmental organisations as well as individuals including farmers.

The main project activities included comprehensive literature review, consultations with target institutions and a structured field survey. The consultations involved direct visits and discussions, a seminar and workshop, with the target institutions.

5.0 Project Outputs

There are two distinct semi-arid resource zones located in the central part and the south eastern part of the country. Rainfall regimes in these zones vary between 500-800 mm per year for the central zone and 600-800 mm per year for the south eastern zone.

Catchment resources are generally topographically delineated and usually drained by a single river system. This less so for the central semi-arid zone with no permanent rivers. The main catchment resources include land and forests, water, and wildlife. Management of these

catchment resources defers as to whether they are managed at household, village, district or national level. At the catchment as whole few management strategies are elaborate. The major determinants factors in the management of natural resources include - bio-physical and climatic factors, policies, infrastructure, human and social capital. An appraisal of improved resource management options show that there is a growing emphasis on local people's participation in natural resource management. This gives potential for consideration of the role of human and social capital.

6.0 Contribution of outputs

Focus on semi-arid Tanzania is within DFID's objectives in Tanzania. There are a number of projects supported by DFID currently operating in semi-arid Tanzania. It is acknowledged that the semi-arid areas are the least endowed and contribute to the magnitude of poverty in Tanzania. DFID's targeting of these areas is a strategic step in attacking poverty in Tanzania

During implementation, this project involvement of other target stakeholders was achieved through direct contacts and during the seminar and workshop organized by the project. The field work was also reported to the stakeholders who participated in refining and validating the findings. Demand for the report of findings of this project is high and this will be a basis for continued cooperation between SUA and the stakeholders and among the stakeholders themselves. The role of human and social capital has been brought to the fore by this project and has brought forth a lively discussion revolving around the actors appreciation of the importance of human capital aspects and social institutions in natural resource management.

The role of social capital in the context of natural resource use in semi-arid Tanzania is not well documented and basically little research has been undertaken. Furthermore the underlying costs and benefits associated with natural resource development programmes are not clearly articulated and this calls for further research in these areas

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Management in Semi-Arid Tanzania

List of Abbreviations and Acronyms

DFID	Department for International Development
HADO	<i>Hifadhi Ardhi Dodoma</i>
IRA	Institute of Resource Assessment of the University of Dar-es-Salaam
LRDC	Land Resources Development Centre
NGO	Non-Governmental Organization
NR	Natural Resources
NRI	Natural Resources Institute of the UK
NRM	Natural Resources Management
ODA	Overseas Development Administration
PRA	Participatory Rapid Appraisal
REPOA	Research on Poverty Alleviation
RWH	Rain water harvesting
SAA	Semi-Arid Areas
SUA	Sokoine University of Agriculture
UDSM	University of Dar-es-Salaam
UNDP	United Nations Development Programme

1 Background

1.1 Project goal

Traditional practices and recent technical interventions have failed to mitigate increasing poverty and the bio-physical problems affecting semi-arid Tanzania. This research project seeks to understand the interdependence between catchment management practices, human resources, and social (or institutional) capital. Informed by the analysis of factors determining current management practices, new knowledge on the alignment of costs and benefits with individual and social priorities, are used to assess the feasibility of improved management strategies, and their likely effect on the poor. New approaches to NR management which benefit the poor, are identified, and their development facilitated through the project's inclusive approach to working with key stakeholders

1.2 Importance of the researchable constraints

Tanzania's semi-arid lands are characterised by environmental degradation and increasing poverty (UNDP, 1997; Narayan, 1997). Increases in human and livestock populations have led to soil erosion and land degradation, and hence to poor productivity and low carrying capacities. Despite erratic and poorly distributed rainfall, extension has for many years promoted cultural and husbandry practices which increase outputs. Emphasis on the availability of water has traditionally received little attention. During the dry season, domestic and livestock use in many semi-arid areas, is dependent on ground water, and women spend several hours per day fetching water. Soil and water management have been recognised as key factors in increasing crop and livestock outputs in the semi-arid areas (Christianson and Kikula, 1996). Competition for scarce resources (such as water, grazing land and forest products) between and within different sets of resource users - pastoralists, agro-pastoralists, and smallholders, conservation, tourism and hunting interests - has already led to conflict (Lane and Moorehead, 1996; Igoe, 1999; Ndagala, 1999).

Within the changing social, economic and environmental context - albeit much of it beyond local or even national control - innovative technical solutions have however, largely failed to mitigate bio-physical factors such as low and unpredictable rainfall and declining soil fertility let alone address the complex and dynamic links between poverty and environmental degradation (Boesen *et al.*, 1996; Christiansson and Kikula, 1996; Mascarenhas, 1995).

While there have been many projects which focused on aspects of catchment management, either to seek increased productivity, or to address issues of degradation and promote sustainable agricultural practices, there has been no systematic evaluation of the respective human and social capital requirements, in the diverse practices associated with NR management and conservation. Similarly there has been no systematic evaluation of the incentives and constraints on individuals to conserve resources, used either privately or in common, or of the social costs and benefits associated with the management of common pool resources.

The project has developed a comprehensive understanding of current management practices for resources used both privately and in common, and their impact on the sustainability of catchment resources as a whole. The project focuses on the role of human and social capital in NR management. The project also applied an inclusive and responsive learning process approach in line with the core principles associated with poverty focussed sustainable

livelihoods approaches. Key formal institutions with influence over or responsibilities for policy and planning have been brought aboard during project implementation. According to Ashley and Carney (1999) sustainable livelihood approaches include activities which are people centered, responsive and participatory, multi-leveled, conducted in partnership (public and private), balancing economic, institutional, social and environmental sustainability, and giving recognition to the dynamic nature of livelihood strategies.

1.3 Semi aridity and poverty: Significant previous research carried out

The semi-arid lands of Tanzania are estimated to occupy between a quarter to a third of the mainland area and are used by 20% to 30% of the population. Livelihood opportunities in these areas are constrained by low and unpredictable rainfall and by relatively poor soils, and hitherto in much of the area, by tsetse infestation (NRI, 1996; DFID, 1999). While there have been many studies in Tanzania using different criteria for defining poverty (nutrition-based definitions, income and standards of living assessments, relative poverty approaches, eg M S D Bagachwa (editor), 1994; or REPOA's Special Papers 1-14, or Research Reports), these works typically estimate that more than half of the entire population in Tanzania live in poverty, and that the vast majority of the poor live in the rural areas.

Although some commentators focus on the benefits of liberalisation for diversifying livelihood portfolios (Booth *et al* reported in Ellis and Collinson), others emphasize negative impacts, both directly and indirectly through the interplay between poverty and environmental damage (see Mboya *et al*, 1995; Bagachwa and Limbu, 1995). Referring expressly to the semi-arid areas, one researcher concludes with the following reference (Mascarenhas, 1995):

"Now there is a famine in the land.. Then they dug another well, and they quarreled over that also; so he called it Sitnah, Enmity." (Genesis 26:1,17-21).

Poor and near-poor families frequently lack human capital - skills, knowledge, good health and/or the ability to labour - and in Tanzania these indicators of human development are on the decline (UNDP, 1997). Levels of social capital - kinship ties, associations, networks, norms and trusts - crucial to determining the influence a community or individual may have over access to and control of resources, are less clear amongst the diverse groups who dwell in the semi-arid areas. The project draws together a wide range of literature on catchment strategies in semi arid areas with a focus on the role of human and social capital in natural resource management. Available literature documents on the prevailing sectoral planning approach to catchment development, the lack of harmonization and coordination of activities throughout the catchment and especially downstream and upstream conflicts. A significant body of work exist which is concerned with the plight of people in Tanzania's semi-arid and arid areas.

1.4 Livelihood assets and natural resources management in semi-arid areas

There is a general awareness on the need to conserve and manage natural resources. The limited success of earlier interventions strategies have promoted the emphasis on participation in natural resource management and new livelihood approaches that take into account of people's capabilities as well as their needs. The assessment of natural resources management strategies is based on various criteria such as contribution to livelihoods, human and social capital considerations and sustainability requirements.

Human and social capital are the constituent components of livelihood assets that are incorporated in the sustainable livelihood framework. The other assets are natural capital, financial capital and physical capital. Assets or the lack of them are fundamental to livelihood strategies (Ellis, 1999). Livelihood framework is a tool aimed at improving the understanding of livelihoods with particular emphasis to the poor. It contains the main factors that affect people's livelihood, and typical relationship between these. It follows therefore that in order to have an understanding of the role of human and social capital it is important to comprehend the components of the sustainable livelihood framework. There is a relationship between the determinants of human capital and poverty

1.5 How demand for the project was identified

DFID development assistance to Tanzania is outlined in the Country Strategy Paper. Poverty eradication is the major goal and it is realized that this goal can be achieved when implemented along other measures supporting improvements in productivity and the enhancement of the poor's participation in development processes and activities.

During the early part of the research the sustainable livelihoods conceptual framework being advocated by DFID and other agencies such as the World bank was revisited. A number of development organizations, agencies and government departments were found to subscribe to the livelihoods framework approach. Literature review and direct consultations with agencies within Tanzania has revealed that the livelihoods approach is a major conceptual tool in their development work. A number of NGOs that are supporting development projects and programs in Tanzania have closely related Sustainable Livelihood frameworks although there may be minor differences among them. It was further established that the Tanzanian government ascribes to the livelihoods approach and this is ascertained by a number of policy statements such as the Poverty Eradication Strategy, Environment Management Policy and several other policy statements

2 Project purpose

The project aims to comprehensively document current catchment management practices and identify researchable constraints on the development of new resource management strategies contributing to the wellbeing and livelihoods of the poor.

Stakeholders with interests in the livelihoods of vulnerable people in semi-arid areas will better understand the contributions of and demands on, human and social capital respectively, to catchment management. This knowledge will advance the development - through policy, research and practice - of new approaches to natural resources management which benefit the poor.

3 Research Activities

3.1 Detailed description of all the research activities (research studies, surveys etc.) conducted to achieve the outputs of the project

The project aims to realize strategies for the integrated management of crop and livestock production at the catchment level which benefit the poor. The project aims to optimize the understanding and uptake of human and social capital issues by key institutions through an inclusive learning process approach, to test whether their inclusion will improve the success of catchment resource management. These institutions are either engaged in research or development, and have explicit objectives relating to promoting the sustainable livelihoods of poor people in semi-arid lands, or are mandated through their commissions to work to these ends. The project processes and research findings advance the capacity of the target institutions to tackle poverty. In the case of agencies that operate at the grass roots level such as local governments and NGOs, the use of strategies better informed by the role of human and social capital in NRM ultimately provide direct and discrete benefits. The focus on peoples' livelihoods and assets, as opposed to their needs, is linked to approaches which seek sustainable solutions. The main research activities and associated organisations that were drawn into the research process are outlined below. At the initial stage interaction between the two collaborating institutions i.e. SUA and NRI was a first major step as outlined below.

3.1.1 Inception Meeting

A joint inception meeting was carried out by NRI and SUA. Researchers from the two institutions met in Morogoro to plan the research activities and to acquaint with each other . Minutes of the inception meeting were produced and are attached as Annex 1.

The objectives of the inception meeting were::

- To reach agreement on time-tabling of scheduled activities under each project and the roles and responsibilities of individuals from NRI and SUA.
- To begin the process of engagement with key stakeholders for both projects.
- To contribute to strengthening institutional relationships between NRI and SUA and other Tanzanian institutions.

The meeting covered the following themes:

- Differences and similarities between “Understanding Household Coping Strategies In Semi-Arid Tanzania” and “Human and Social Capital’s Role in NR Management in Semi-Arid Tanzania”.
- Detailed allocation of scope, tasks, responsibilities and timings for literature reviews, brainstorming seminar and on-going consultation process.
- Less detailed timetable for other project activities.

3.1.2 Literature and data reviews

Comprehensive literature review was undertaken on natural resource management in semi-arid areas, catchment management, livelihood strategies and livelihood assets. International, Tanzanian specific literature and gray literature was reviewed. The literature review was undertaken in collaboration with NRI. Annex 4 is the comprehensive literature review and an annotated bibliography was subsequently developed (Annex 5).

3.1.3 Programme of consultations with target institutions and other stakeholders

Annex 2 provides brief overviews of the interactions that were made between the project with target institutions and other stakeholders interested in livelihoods and natural resource of the poor in semi-arid areas of Tanzania. Through visits to target institutions, seminar and workshop a working relationship was established for them to participate in the project process. Parallel research projects were also consulted.

3.1.4 Seminar with collaborators and key target institutions

A review and validation of current catchment management practices with particular reference to difficulties associated with perceptions of practice, and therefore with classification, and identification of gaps. The proceedings of the seminar are attached in Annex 2.

3.1.5 Focussed field work

Following the comprehensive literature review mentioned above and consultations with TI's case study field work was undertaken in two catchments to cross check, validate and bring up to date the analysis of factors determining management practices in the study area. The case study analytical report is attached in Annex 6.

The case studies were undertaken using participatory and focused interview methods including structured questionnaires. The case studies were located in central plateau and the semi arid part of the southern highlands zone. In the central region the study was conducted in the Bubu river catchment while the other case study was conducted in Iringa district in the semi arid part of the Ruaha river catchment (part of the Rufiji River Basin).

3.1.6 Workshop with target institutions and other stakeholders

Research results were presented to the key target institutions with which the project collaborated with. A report of proceedings of the workshop is attached in Annex 7.

3.1.7 Facilities, expertise and special resources

The project approach is one which highlights the "process" by which research is undertaken, giving emphasis to collaboration and to interdisciplinary approaches within the research

community. Target institutions with overlapping interests in the research theme or area were identified. This enlisted their ownership and hence enhanced the promotion pathways. In the course of this research, informal and positive exchanges have taken place between the research team and individual players in key target institutions. A number of contacts the project made are as follows:

- Other departments and research groups at Sokoine University of Agriculture and especially the Soil and Water Management Research Group.
- The Institute of Resource Assessment (IRA) of the University of Dar-es-Salaam. IRA has substantive research experience in semi arid parts of Dodoma and Iringa,
- Research in Poverty Alleviation in Tanzania (REPOA).
- Economic and Social Research Foundation (ESRF) based in Dar-es-Salaam.
- Government departments and projects with interest in semi-arid arid areas: These include projects such as HADO (Hifadhi Ardhi Dodoma). HADO has been involved in soil conservation and management in Dodoma region for many years.
- A number of non-governmental organisations are involved in environmental issues. Collaboration with the project was established in the two case study areas.

3.1.8 Modifications of project activities

The project time frame was initially put at 6 months from July to December, 2000. Unforeseeable events at Sokoine University of Agriculture (student strike) and the Tanzanian General Election in late October 2000 interfered with the scheduling of activities. At NRI organisational changes and restructuring had an impact on the work schedule of the team members.

3.1.9 Extent of achievement of planned inputs

The project through enlisting of target institutions collaborated with them throughout the research process. The key actors were involved through the visits made to them, and their participation in the seminar and workshop. An NGO, Local Perspectives, was initially invited to participate in the research process but had to withdraw due to movement of staff to other activities. Inputs from IRA of the University of Dar-es-Salaam was enlisted through the participation of Dr. Faustin Maganga and to some extent as well Dr. Hilda Kiwasilla.

4 Outputs

4.1 Project outputs

The project aimed at:

- Comprehensive description of the way catchment resources are currently managed, developed. This is a synopsis of current information and provides the background for further aspects of this study,
- Key factors determining management practices, their implications re the investment of human and social capital, identified and analysed. Concepts of human and social capital in the context of natural resources management are clarified, and a rigorous understanding of their relationship to the dynamics of natural resource management, developed. Researchable constraints on the role of human and social capital in NR management are identified and prioritised. This output is based on a review of universal and Tanzania specific literature, focused-fieldwork to cross-check and fill gaps, and a seminar and workshop involving key target institutions and stakeholders.
- Assessment of improved resource management strategies, associated costs and benefits at the catchment level, local institutional implications, and their likely effect on the livelihoods of the poor, synthesized and disseminated. Incorporating new knowledge from outputs 1 and 2, and including more detailed analysis and case study work in two representative catchments - to be decided after initial consultations with target institutions - the assessment will identify key criteria for the prioritisation of improved interventions, leading to recommendations for new approaches

4.2 The research results and products achieved by the project.

4.2.1 Output 1

Synopsis of current information for semi-arid areas of Tanzania

The definition of arid and semi-arid areas in Tanzania is acknowledged to be problematic (Boesen, 1999; Mascarenhas, 1995). Several different definitions are in use (see Box 1 for further details). This study has utilised the agro-ecological classification published by ODA/NRI (LRDC 1987; NRI 1991; NRI 1996). This classification identified two distinct semi-arid resource zones in Tanzania, one in the central part of the country and one in the south east (Figure 1). Rainfall throughout both areas is uni-modal, falling within the December to March period. Importantly, in the central zone (500 to 800 mm per year) rainfall is more unreliable than that in the south eastern zone (600 to 800 mm).

Areas with rainfall less than about 500 mm or greater than 800 mm have been excluded from this study. Consequently the arid lands in the north of Tanzania (that might be termed semi-arid in some other classifications) are not considered. People living in these areas face different configurations of livelihood constraints and opportunities to those living in the semi-arid areas, a greater reliance on pastoralism for example as this area is home to the Maasai.

Box 1 Definitions of semi-arid lands in Tanzania

- Tanzania's mainland has been characterised variously between seven and nine major physiographic regions. These include: I. coast; II. arid lands; III. semi-arid lands; IV. plateaux; V. southern and western highlands; VI. northern highlands and; VII. alluvial plains.
- Mascarenhas (1995) remarks that depending on the criteria used, one estimate shows the Tanzanian drylands as covering between 25% and 75% of the country and another between 45% and 75%.
- The Renewable Natural Resources Research Strategy (RNRRS), published in 1994 by ODA, defines a semi-arid production system as being found in:
“regions where the mean monthly temperature is above 18 degrees centigrade and where there is one or more season during which evapotranspiration exceeds precipitation. Although the mean annual rainfall is in the range 400 – 1,200 mm, lack of water is a major constraint to production”.
Under this very broad definition, it is suggested that 80-90 percent of Tanzania would be considered semi-arid (Bourn and Blench, 1999: 7).
- HTS (1999) notes that overall, semi-arid lands occupy a third of the country and are used by 20 – 30% of the population. The World Bank gives a lower figure in terms of area, giving an estimate of 21.1 million hectares for both semi-arid and arid land taken together (World Bank: 1994: 14), equating to about 22% of the total land area.

The semi-arid lands were delineated by ODA / NRI in relation to Tanzania's administrative regions (LRDC 1987; NRI 1991; NRI 1996). This classification has been used widely by the World Bank amongst others (World Bank 1994).

Central semi-arid zone

The central semi-arid zone overlaps eight regions including much of Shinyanga, Singida and Dodoma, and less of Mwanza, Arusha, Tabora, Iringa and Mbeya. The zone is a plateau between 1000 and 1500m in altitude consisting of gently undulating plains with some rocky hills and low scarps associated with the formation of the rift valleys. The soils are well-drained sands of low fertility on the uplands and alluvial hardpan and salt affected soils in shallow internal drainage areas of the eastern and Lake Eyasi rift valleys. Extensive flat plains in the north, around Shinyanga, are covered by black cracking clays formed in an old lake bed.

The main rainy season is in one season from December to March with between 70 and 90 days of rain per year (500 to 800 mm total). The bimodal rainfall mode associated with the northeastern highlands and the Lake Victoria basin only touches northern areas of the central zone.

Box 2 Erratic rainfall Responses to a livelihood security assessment in Shinyanga in 1995 suggested the rainfall had been erratic for at least a decade, and identified the years 1984, 1992 and 1994 as being particularly bad.

Rainfall tends to be unreliable with almost all areas being drought prone. Soil erosion and bush encroachment in parts of this zone have been a growing concern since the late 1920s. Cultivation practices, deforestation and overgrazing have been identified as the major causes of soil degradation (Dejene *et al*, 1997).

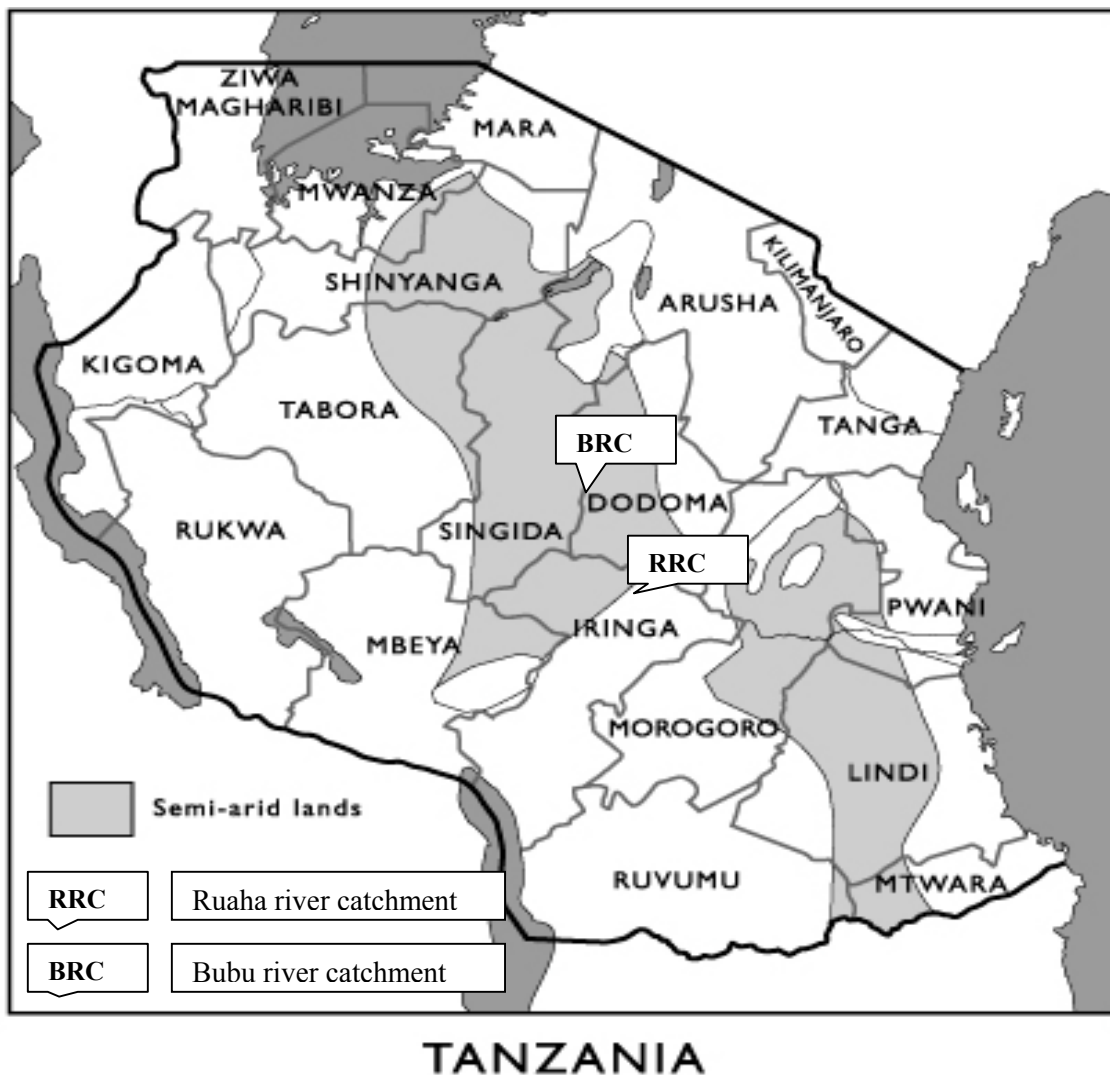


Figure 1 Map of semi-arid zones in Tanzania

South-eastern semi-arid zone

The south-eastern zone includes much of Morogoro region, except for the Kilombero and Wami basins and the Uluguru mountains, the central half of Lindi, western quarter of Mtwara, and eastern tip of Ruvuma and a small part of Coast region. It is low lying at between 200 and 600m above sea level. Topography is characterised by flat or gently undulating plains with some rocky hills and strongly dissected areas. The soils in the south and around Morogoro are moderately fertile loams and clays, whilst those in the centre are infertile sands. Rainfall for this zone is lowest in the centre of the zone (around 600 mm per year) rising towards the north and south (to around 800 mm per year).

This output has been accomplished by the production of a preliminary analytical report based on literature review and consultations with key target institutions and stakeholders. The PAR is a comprehensive overview of current catchment management practices and the role of human and social capital in NRM. Tanzania's semi-arid lands are characterised by low rainfall, with high variability in quantity, duration and onset and end dates. Through the review of literature and other sources it is found that a number of attempts have been made to identify a way to classify the different agro-ecological zones in Tanzania. The best approach

has been identified as that using the farming system as a consequence of the physical environment rather than one of its defining characteristics.

The literature review and consultation were accomplished through collaboration between SUA and NRI. Exchange of literature and joint visits to TIs and other stakeholders were made.

The PAR comprehensively documents current catchment management practices. Existing technical and environmental analyses are complemented by analysis of the economic, social and institutional factors shaping resource management. Within an overall sustainable livelihoods approach, basic conceptual models (offering an order of magnitude and insight) are used to explore the attractiveness or otherwise of management practices to the poor in SAA.

The literature review is complemented by consultations with target institutions and other stakeholders. The literature review covers the following areas:

Description of the SAA of Tanzania

Background review of the role of human and social capital in SAA of Tanzania

Linking people and NRM i.e. people's dependence on natural resources for livelihood and a review of current NR management practices with particular reference to the role of human and social capital.

Group plenary presentations as summarised in the seminar report provide a consensus overview of the current understanding of NRM, SAA, livelihood strategies and the role of human and social capital

Catchment resources (definition and geographical coverage)

Strictly speaking a catchment is a topographically delineated area that is drained by a single water course system. The catchment is thus a functional unit established by physical relationships where upstream land use incites a chain of environmental impacts affecting downstream areas. Other key characteristics of catchments are that they hold multiple, interconnected natural resources: soil, water and vegetation. Impact on one resource invariably affect the status of others.

Catchment management differs from forestry, crop production and water development activities. At field level there were as well different understandings of what is meant by catchment. The Agricultural Officer at Dodoma viewed catchment as a low lying area/basin where water collects and is useful for crop production. The Forest Officer on the other hand conceptualises catchment as synonymous to catchment forests. The irrigation project conceptualizes catchment as the macro-catchment i.e. macro catchments are those collecting and concentrating water from a distance to the area of intervention (cropped area), also defined as such by the RWH at SUA.

Mapping of catchment resources - management

The physical relationships in a catchment only become an issue when individuals have vested interests in a catchment or a portion of a catchment. These vested interests are separated by political/administrative boundaries or institutional arrangements, which normally do not correspond to the topographic limits of catchments. The corollary to the "water flows downhill" tenet is the fact that it does so irrespective of political boundaries. Thus in addition

to the catchment being a functional unit for physical resources, the catchment is a functional unit of multiple and independent vested interests.

The concept of catchment can be applied to the full range of catchment dimension and problem type; from soil erosion in five hectare, peasant occupied upland catchment to pollution of water bodies. Catchment management might include agriculture, soil conservation and forestry activities, but differs from these separate fields in recognising and focussing on land use and its impacts on other catchment interests due to trans-boundary water flow. The fact that water flows down-hill, and does so irrespective of political boundaries, is the central tenet of catchment management. The problem of co-ordination and co-operation is thus inherent to catchment management.

Natural Resource Management Framework

In Tanzania the majority of the poor people live in the rural areas and are predominantly dependent on renewable natural resources for their livelihoods – through agriculture or pastoralism, or from fisheries, forests or wildlife. As a result there is a clear interrelationship between food security, natural resources management, agriculture and the environment in the rural areas. It is also important to note that government interventions (through policies, laws and by-laws), technologies, available knowledge and actions that promote pro-poor people as well as the protection and better management of the natural and physical environment contribute to poverty elimination and thus ensure food security. To ensure the above mentioned, there is a need of ensuring that improved natural resource management are undertaken at different levels. Table 1 shows a framework of natural resources management at different levels by resource type.

Table 1 Natural resources management framework

Resource	Management Level	USE TYPE	Management Strategies	Assessment
Land	Household	Agriculture	Land management practices: <ul style="list-style-type: none"> Technologies Knowledge 	Contribute to the livelihood of the people. Shaped by the quality of both human and social capital.
	Village	Allocated land	Individual ownership (households, organizations) Village land use plan Village land titling Common property By-laws	Livelihood of the people shaped by strength of the village government, quality of human and social capital
		Unallocated land	Open access	Over use may lead to degradation. Need to be converted to other property regimes.
	District (National)	Allocated (village, towns)	Owners By-laws Land use policy Legal measures	Shaped by existing laws, by-laws and policies (including enforcement)
		Reserved Protected land	State land/state agencies Land laws	Strict laws and enforcement.

	Catchment	Agricultural land	Individual ownership, Village and institutional ownership Laws and by-laws	Contribute to livelihood, shaped by existing laws and by-laws.
Water	Household	Agriculture Domestic	User groups Management practices <ul style="list-style-type: none"> Technologies Knowledge 	Contribute to Livelihood of the people, shaped by the quality of both human and social capital. Strong user groups contributes to efficiency in use
	Village	Agriculture Domestic	By-laws Water Users Associations Policies Water sub-committee Water laws/legal measures	Contribute to peoples' livelihoods. Strong social capital (groups) , policies and laws are important
	District	Agriculture	As in village above	As in village above
		Domestic Industrial	Water authorities	Strong water institutions are required
	Catchment (Basin)	Agriculture Hydro power	Basin management Laws, policies, by-laws	Strong water policies and laws to allow allocation among different users
	National	Agriculture Hydro power Domestic, Industrial	Policies e.g. water policy Laws e.g. water laws	Strong water policies and laws to allow allocation among different users
Wild life	Household	Harvesting	Laws and by-laws (protected species) Management strategies <ul style="list-style-type: none"> Technologies Knowledge 	Contribute to peoples' livelihoods. People participation in wildlife management may improve the resource availability
	Village	Harvesting Reserved/ protected	Laws and By-laws Village land use plans Licensing Policy and legal Policing	Contribute to livelihoods. May be shaped by proper licensing, laws, policies
	District (National)	As above	As above	As above
	Catchment	Reserve/conservation Protection of species	Laws and by-laws Policing	Strong laws and by-laws are required
		Non-consumptive (aesthetic values)	<ul style="list-style-type: none"> Laws and national agencies e.g. national parks Community Based Management e.g. Community based wild life management 	Community based management systems may assist. However, strong laws and by-laws are necessary

Forest	Household (e.g. traditional forests and wood lots)	Agricultural use Harvesting (timber and non-timber products)	Laws and by-laws (protected species) Management strategies <ul style="list-style-type: none"> Technologies Knowledge 	Contribute to peoples' livelihoods. People participation in forest management may improve the resource availability
	Village	Agricultural use Harvesting Reserved/ protected	Laws and By-laws Village land use plans Licensing Policy and legal Policing	Contribute to livelihoods. May be shaped by proper licensing, laws, policies
	District (National)	As above	As above	As above
	Catchment	Reserve/conservation Protection of water sources	Laws and by-laws Policing	Strong laws and by-laws are required
		Non-consumptive (aesthetic values)	<ul style="list-style-type: none"> Laws and national agencies e.g. national parks Community Based Management e.g. Joint Forest Management, Community based wild life management 	Community based management systems may assist. However, strong laws and by-laws are necessary

The framework contains different types of resources, management level, use type management strategies and assessment. The assessments of the resource management strategies were based on various criteria such as contribution to livelihood, human and social capital considerations and sustainability requirements. For example resource management strategies at household level depend on individual household management practices mentioned under 1.6 above. Generally at household level the strategies contribute to livelihood strategies of the households and are shaped by the quality/quantity of human and social capital available such as household composition, health and nutritional status of the members, dependency ratio, education and knowledge levels, membership of different groups etc.

At village level over all the resources management strategies contributes to the livelihood of people. Sustainability is shaped by various factors such as the strength of the village government, quality/quantity of human and social capital, proper licensing, laws and policies, and joint/community natural resource management strategies (Table 1).

4.2.2 Output 2

Key factors determining management practices, their implications re: the investment of human and social capital, identified and analysed.

Key determining factors (of management practices) for semi-arid Tanzania.

The main problem affecting the semi-arid zone is low and unreliable crop and livestock production. The main effect of this problem is low food supply, sufficiency and security. The main contributing cause of the problem is low availability of soil moisture. This is in turn, caused by low rainfall, erratic distribution of rainfall, high run-off losses and high evaporation losses. Apart from the biophysical and climatic constraints NR management in the SAA is influenced by current policies, infrastructure and other external shocks.

Intervention policies in NR management that target the poorest of the poor have indicated that this may not be the right approach. Appropriate intervention strategies need to be in place. For example capacity building may need to precede production innovations. In an irrigation project funded by IFAD it was seen that the poorest farmers who had been targeted to benefit most ended up selling their land to relatively richer farmers. The poorest of the farmers were unable to invest into recommended agricultural practices and could not afford to hire labour for labour intensive farm operations such as the construction of irrigation bunds. Transport constraints also can affect the poorest of the poor in that such farmers are not able to access input and output markets.

Validation of determinant factors and implications for human and social capital in NRM

The PRA and structured survey results indicate that the human capital and social capital are important livelihood assets that have not received commensurate attention at policy, research and implementation levels. Poor people in the SAA are characterized as having low human capital capabilities and have not adequately harnessed their social capital.

There is a general awareness on the need to conserve and manage natural resources. Evidence for this is provided by the existence of deliberate policies within the government, NGOs and other private initiatives to promote natural resource and environmental strategies. A number of initiatives at government level are in place. An example in the study area is the HADO programme. Other interventions are being undertaken by NGOs and local community efforts. A number of research efforts are also in place at established institutions and other specified research projects.

Currently there is a growing interest in exploring the potential of human and social capital. The emphasis on local people's participation in NRM to circumvent the effects of earlier state or top down approaches in NRM as well as to the current emphasis on sustainable agriculture. Household Income and Social Capital in Rural Tanzania, suggests for example that a one standard deviation increase in village social capital increases household expenditure per person - a proxy for income - by at least 20 to 30 percent. Thus many in country agencies, both state and civil society are presently interested in a better understanding of the role of human and social capital, and link this to the development of sustainable NRM.

Human and social capital are the constituent components of livelihood assets and the livelihood framework is an approach to researching on the issues related to livelihood assets including the role of human and social capital. The potential for and research on human and social capital is currently under-exploited. Human and social capital is not properly harnessed and any available efforts may not be directly tied to NR management. For example social networks may exist that are not necessarily related to NR management. Some social activities for example the existence of Savings and Credit Organisation in one of the study villages and a Water Users Association can largely be attributed to external influences. There is scant knowledge on forces leading to the formation of indigenous social networks.

Focussed field work undertaken in Dodoma and Iringa regions covered selected semi-arid water catchment systems - Bubu river catchment in Dodoma region and Ruaha river catchment in Iringa region. Bubu river is seasonal and this gives it its unique importance in the area it covers. The system extends from the south of Arusha region, covers parts of eastern Singida region and Dodoma region. The largest part of the Bubu river system is

located in Dodoma and culminates into the Bahi swamp which turns into a full water body in a season with high rainfall. The system is part of the central drainage system.

Ruaha river catchment on the other hand is part of the Rufiji river basin. This is an extensive river system covering a variety of agro-ecological areas. The study area for this project was located in the semi arid part of the system. Ruaha river is an all weather river whose tributaries in the semi-arid part are the source of water for domestic and irrigation use by the downstream inhabitants of the semi-arid part of the system.

4.2.3 Output 3

Assessment of improved resource management strategies, associated costs and benefits at the catchment level, local institutional implications, and their likely effect on the livelihoods of the poor, synthesized and disseminated

Appraisal of improved resource management options.

There are a number of interventions to manage NR. Within the study area a number of initiatives on NRM are in place. A major one is the HADO project literally translated as the Dodoma Land Management Project. Under this project and others there have been introduced a number of NR management practices including Rain Water Harvesting techniques, soil fertility improvements such as the use of manure, control of livestock overgrazing, irrigation and afforestation projects. The cost implications for these intervention has been seen as the main constraint to adoption by poor farmers. Manure application for example is a labour intensive farm operation and therefore this may hinder adoption by particularly poorer farmers. Other interventions are also high input demanding and/or labour demanding. Afforestation projects may require the existence of social networks with NR management focus.

Focused field work results

The field work was conducted in two catchments. The first location was in the central semi-arid zone and the second was in the semi-arid part of the Rufiji river basin. The characteristics of the two catchments are presented with their differences emanating from the fact that in central plateau (Bubu river catchment) farmers depend on rainfall while in the Ruaha river catchment the river flows supplement water for agriculture.

The field work documents the survey sample socio-economic characteristics, natural resource management practices undertaken by farmers and human and social capital aspects of the communities in the study area.

The study reveals a dominance of formal rules and regulations in the management of natural resources. The study explored in reliable detail the role of social networks in natural resources management.

Validation of key results

The validation workshop identified key issues for further research and intervention in natural resources management. These include:

- NR ownership methods
- Property rights and land tenure
- Distribution of benefits under collective management
- Complexity of the term poverty
- Corruption in NRM
- Coordination among stakeholders in NRM

- Understanding community, household and intra-household relationship

5 Contribution of Outputs

Focus on semi-arid Tanzania is within DFID's objectives in Tanzania. There are a number of projects supported by DFID currently operating in semi-arid Tanzania. It is acknowledged that the semi-arid areas are the least endowed and contribute to the magnitude of poverty in Tanzania. DFID's targeting of these areas is a strategic step in attacking poverty in Tanzania.

During implementation this project involvement of other target stakeholders was achieved through direct contacts and during the seminar and workshop organized by the project. The field work was also reported to the stakeholders who participated in refining and validating the findings. Demand for the report of findings of this project is high and this will be a basis for continued cooperation between SUA and the stakeholders and among the stakeholders themselves. The role of human and social capital has been brought to the fore by this project and has brought forth a lively discussion revolving around the actors' appreciation of the importance of human capital aspects and social institutions in natural resource management.

The underlying costs and benefits associated with natural resource development programmes are not clearly articulated and this calls for further research in this area.

6 Project reports

The research has produced a number of reports internally. There are also planned scientific publications.

6.1 List of project reports

Title of the report	Identification
Inception Meeting and Target Institutions Consultation report	Annex 1
Proceedings of the Seminar on Livelihoods and Natural Resource Management in Semi-Arid Areas of Tanzania	Annex 2
Preliminary Analytical Report on human and social capital's role in natural resource management in semi arid Tanzania.	Annex 3
Annotated Bibliography	Annex 4
Human and social capital's role in natural resource management in semi-arid Tanzania - Case study results	Annex 5
Proceedings of the validation workshop on livelihood and natural resource management in the semi-arid areas of Tanzania	Annex 6
Household Livelihood Strategies in Semi-Arid Tanzania: Synthesis Report	Annex 7

6.2 Planned scientific publications

The following publications are intended to be developed by the research team and cover various aspects of the study.

- Social capital, economic policy reforms and technology adoption in semi-arid Tanzania.
- Social capital and agricultural market access by farmers in semi-arid areas of Tanzania.

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