AN NCS FOR ZAMBIA

PREPARED BY A DUTCH STUDENT TEAM

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Preface.

As a part of its educational activities, the Centre for Environmental Studies brings together interdisciplinary teams of graduate students. These teams work together in order to gather experience in the field of environmental analysis and planning. At the same time, the team studies are meant to be benificial for society.

At the moment, an NCS is being prepared by the Zambian government, in co-operation with the IUCN.
At the onset of this study it has been agreed with the IUCN that the NCS student-team research should not interfere in the process of development of the real Zambian, NCS. Therefore, it is to be noted that this report is the result of an educational exercise, without any official status, intended to be only an informal contribution.

For a student team in a Western country it is crucial to realize in which way this contribution to the Zambian NCS process may be achieved. The adopted line of work has been to focus on the substantial analysis and strategy design, i.e. the process towards the NCS *content*, rather than focussing on the overall aspects of the NCS process, including NCS promotion, negotiation, institutional framework, implementation and the like. In this way, the group may have produced something different from a 'normal' NCS, e.g., in its degree of being a mapped plan or its degree of incorporating regional objectives. In being different, it is hoped to be valuable.

The Zambian project group consisted of W.T. de Groot and T. van Tilburg (supervision) and M.R. Bakker (economy), E. van Beusekom (landscape planning), P. Bont (biology), W. Borghuis (landscape ecology), N. Giling(anthropology), J. ten Hove(anthropology), R. Neefjes (economy), B. Persoon (biology), R. van der Voort (biology) and J. van Wieringen (geography).

The project group expresses the hope that the result of its study meets the standard of the numerous persons and institutions which supported it; among those, special thanks are due to I. Duchart, C. Geerling, A.K. Klaassebos, P. Nas, H.Th. Riezebos, J. Smeets, L. van der Berg, A. den Held, D. Jaeger, R. Koelstra, N. Long and G. Prins.

This report is a summary of a 700 page draft report of the Zambia project group, emphasizing its theoretical basis and final results. The empirical basis and intermediary results will be touched only very superficially. P. Bont, R. van der Voort, J. van Wieringen and N. Kösters contributed to the summarizing effort.

1.1. THE WORLD CONSERVATION STRATEGY STANDPOINT.

Orthodox economic theory emphasises the need for economic growth, which essentially means more paid output. Ecology emphasises conservation of the environment and the tendency of the growth process to destroy its very basis, the natural resources.
It would appear that a clear-cut contradiction exists between these two approaches. This becomes most salient if the concept of Gross National Product (GNP), defined in its orthodox way, is used as the growth indicator.

In the GNP concept,
- Luxery goods and basic needs are incorporated by their market prices, thereby over-estimating the value of benefits for high income strata of society
- a large range of collective goods, like infrastructure or natural resources, is priced at production cost only or not priced at all, favouring the private commodities in the GNP measurement
- non-productive activities, like those neccessary to make good for natural processes that nature once provided for free, e.g., water purification, are priced and hence counted as positive in the GNP, while they are essentially a non-productive loss,
- self-providing, non-marketed activities like subsistence farming and bartering are not taken up in the GNP; hence, their growth or decline goes unnoticed.

Within economic theory, attemps are nowadays being made to redefine the growth concept (e.g., Wicke, 1982). This will partly reconcile the economic and ecological points of view.

Traditionally, the ecological point of view has been related to the public concern about the destruction of nature in Western countries. In this context, the intrinsic value of nature tended to dominate the strictly utilistic "resource" functions of nature. In the developing countries, man's daily existence still depends strongly on these functions; this has induced a shift in emphasis from the moral to the utilitic aims of conservation. (In the next paragraph, we will further explore this).

As a general result, the traditional gap between ecology and economics is being partly bridged from both sides, although many differences remain, like the emphasis put on the interest of future generations. In the World Conservation Strategy (WCS), the IUCN document pertaining to the problem of sustainability and development, the aims of conservation are stated as follows:
- to maintain essential ecological processes and life support systems (such as soil regeneration and cleaning of waters) on which human survival depends;
- to preserve genetic diversity, as a basic for the above processes and innovation in medicine, agriculture and industry;
- to ensure sustainable utilisation of species and ecosystems (like fish and forests), which support local communities and industries.

1.2. Planning objectives for a National Conservation Strategy.

The WCS called upon all nations to prepare their own programmes for promoting development along the WCS line.
At present more than 30 countries, among which Zambia, are in the process of preparing these National Conservation Strategies (NCS). The broad purpose of an NCS is to offer guidance to government, resource users and consumers about what seem to be the more sustainable development paths, using the WCS as a basic guide.
Since an NCS is a local 'offspring' of the WCS, it may seem feasible to adopt the WCS-formulation of conservation aims, only specifying them towards the Zambian situation.
In doing so, however, problems are encountered.

First of all, the WCS objectives are entirely utilistic. This contrasts with other views on the normative basis for conservation, in which an itrinsic value is attributed to species and ecosystems. This attitude has deep roots in Western as well as Asian, African and traditional American culture. In modern societies the intrinsic value of nature is expressed in the government objectives as well as public action. In view of man's life circumstances in the Third World, it may be deemed justifiable not to stress man's responsibility for nature. However, if one ignores this aspect altogether, one runs the risk of double-heartedness, creating an artifical rift between Third World and First World arguments, which may result in inconsistent proposals.
Moreover, in view of the rapid development of biochemistry and genetic manupulation, a world able to survive on artificial photosynthesis, deepfrozen genes and manipulated evolution is quite imaginable. The more such a world approaches, the more the utilistic argument loses its power. The overlap of the result of the argument of mankind's survival and the argument of mankind's responsibility is a temporary coincidence. For these reasons, in the NCS objectives below, the two types of arguments are both adopted.

Secondly, the NCS is to be integrated in the whole of a countries strategic planning. Hence, the NCS objectives should include at least one overall national objective, in order to derive guiding principles from it and link NCS-elements with other plans. Underneath, objective nr. 5 will repeat this principle.

Thirdly, conceptual problems are encountered, which hamper a consistent operationalisation of the objectives. For instance:

(1) The objectives not only contain normative elements, but also empirical and essentiality hypotheses of interdependency; if these hypotheses are partly falsifiable (which they are), the normative objectives are made dependent on the outcome of empirical debates.
(2) The objectives are not exhaustive. For instance, is genetic diversity the only information aspect of nature to be protected? Are no patterns, only processes to be maintained?

(3) Cannot the objectives be linked with concepts of ecological theory, e.g., the concepts of functions, energy and information?

The above considerations have led to a set of NCS objectives which may be more complete, discriminating, normative and theory linked. A principal distinction is made between natural *values* and the functions of nature for man. Within the function concept, three types are distinguished:

- The *spontaneous functions*, i.e., those functions for which nobody has to invest or act in any way: energy is trapped by vegetation, floods are regulated by swamps, soils are protected, sandy ridges are deposited, genes come into existence and the landscape develops its information content for free. In a general way, they may be divided in energy-related and information-related functions, linking up with energy analysis and theory and with information theory, respectively.
- The *extensive production functions*, i.e., those functions for which hardly anything else but human labour is to be invested to obtain a yield.
- The *intensive production functions*, i.e., those functions for which also substantial non-labour inputs like capital, fertilizer, pesticides and energy are neccessary to obtain a yield.

The intensive and extensive production functions differentiate in an NCS-relevant way. The extensive systems work without external, exhaustible inputs and are potentially infinitely sustainable for that reason. At the same time, however, they may collapse rapidly if their carrying capacity is exceeded, since compensating external inputs do not fit in the system. Hence, population density is the main factor of extensive production systems to be in check. If this succeeds, they usually provide an efficient and secure life basis. The intensive systems can cope with a long range of population densities. Increases of inputs can be accomodated without changing the system's character. Hence, the carrying capacity is a less powerful concept and the sustainability principle may best be operationalized as providing a sufficient level of inputs.

With this background, the NCS objectives have been formulated as follows.

(1) TO PROTECT SPECIES AND ECOSYSTEMS.

This objective is derived from the nature's intrinsic right to live. It may be noted that also ecosystems are attributed an intrinsic value. This is especially relevant for systems with strong internal relationships, e.g. the tropical rain forest. This objective being purely qualitative, it is not stated how much value is to be attributed to each species or system. This can only be decided upon in a public debate.

In operationalizing the objective, one may arrive at evaluation criteria. For instance, if every species and ecosystem has a right to live, the rare species and systems deserve most of our

attention. And: if ecosystems are to be protected, their components must be maintained at their authentic position. Hence, authenticity (of species position in ecosystems and ecosystem position in landscapes) arises as a second criterium. It may be noted that these criteria also cover the reductionistic and the holistic (organistic) attitude towards nature.

(2) TO PROTECT THE SPONTANEOUS FUNCTIONS OF NATURE.

This objective may be specified as:

- *to protect the spontaneous energetic functions of nature,* comprising such processes as water purification, buffering, oxygen production, soil genesis, decomposition etc.
- *to protect the spontaneous information functions of nature,* comprising such diverse components as genetic diversity, the existence of undisturbed situations for scientific research and the recreational values of species, ecosystems and landscape patterns.

Genetic diversity (the second WCS objective) is incorporated in this value system as one of the spontaneous information functions. It is not only fundamentally but also practically different from the species protection objective (objective No.1). In objective 2, every gene counts equally: in objective 1, species count, and count differently.

(3) TO MAINTAIN EXTENSIVE PRODUCTION FUNCTIONS AT OR BELOW THEIR EXPLOITATION CAPACITY. This objective covers land use systems such as shifting cultivation, fire wood extraction from natural forests, range-land cattle systems, hunting and fisheries.

Essentially the objective is formulated in a "repressive" manner, extensive land use system being efficient but vulnerable.

(4) TO PROVIDE INTENSIVE PRODUCTION FUNCTIONS WITH AN INPUT LEVEL THAT ENSURES SUSTAINABILITY.

This objective covers most of the modern cropping systems, energy-supplemented animal husbandry, fish ponds, forest plantations etc. Essentially, the objective is formulated in a "progressive" manner, for reasons explained above.

(5) TO TAKE INTO ACCOUNT ALL RELEVANT OVERALL DEVELOPMENT AIMS, STRATEGIES, NEEDS AND BOTTLENECKS. These may include the national budget, conditions set by foreign agencies, the balance between regions, cost-benefit rations and the like. In the next paragraph, they will be operationalized further.

1.3. GUIDING PRINCIPLES FOR NCS DESIGN.

The final result of this report is a proposal for an NCS for Zambia, a plan designed by means of the planning design method explained in the next paragraph. As with any plan, be it for a drawing for a house, a commercial marketing plan or a long term policy plan like an NCS, the design process needs some sort of guiding principles as input, besides knowledge about the physical situation, potentials etc. *These guiding principles are derivatives of the planning* objectives, compiled by specifying these objectives, mixing them with knowledge about a country's specific situation.

Theoretically, it would be possible to compile a system of interrelated guiding principles, working from the general NCS-objectives towards more and more concrete principles. In practice, we have found it more effective to start from an even more fundamental and general set of aims, like "freedom" and "harmony". This may be explained as follows. A planning result (a design) is an *ad hoc* reconciliation of conflicting interests and options. Guiding principles in the planning process are most effective if they still retain the conflict of interests in its full spectrum, so that this conflict "arrives at" the *ad hoc* planning problem without first going through a stage op pre-reconciliation *in abstracto*, as in a fact done when intermediate policy objectives are formulated, be it for an NCS or any other strategy. Underneath, the general aims and guiding principles we developed will be stated. It will not be attempted to give a full account of their interrelationships or the way we arrived at them.
The following general aims have been used:
(1) RESPONSIBILITY, which can be specified as:
- responsibility for nature as a value as such;
- responsibility for the physical life basis of future generations;
- responsibility for a country's cultural diversity.
(2) EFFICIENCY, which can be specified into guiding principles concerning the rentability of projects and incentives and the creation of rationality to act on all social system levels on which action is required. The latter will be further explained below.
(3) FREEDOM, which leads to guiding principles concerning self-reliance, the ways to enforce or induce change, and the like.
(4) HARMONY AND JUSTICE, which, for an NCS lead to guiding principles concerning balances of power, income and knowledge between regions, classes and the urban vs. the rural areas.
As can easily be seen, the NCS objectives, stated in the previous paragraph, are included in these aims, expressed in a less abstract and more NCS-directed way.

The first aim, in its responsibility-for-nature aspect, together with the utilistic objective of genetic diversity leads to the following guiding principles:
GP1: PROTECT THE RARE SPECIES AND ECOSYSTEMS IN THEIR AUTHENTIC ECOLOGICAL SETTING, TAKING INTO ACCOUNT THE LONG TERM EFFECTS OF ISOLATION.
Following the general inland theory of species extinction, this can be further specified as:
GP2: IN PLANNING PROTECTION AREAS FOR SPECIES OR ECOSYSTEM PROTECTION, TRY TO MAKE THEM AS LARGE, DIVERSE AND INTERCONNECTED AS POSSIBLE.

First of all, the responsibility for future generations leads to the principle of sustainability. Following NCS-objective nrs. 3 and 4, this gives rise to:

GP3: ASSESS THE CARRYING CAPACITY OF THE EXTENSIVE LAND USE SYSTEMS AND THEIR CURRENT STATUS IN THIS RESPECT, and
GP4: ASSESS THE INPUT REQUIREMENTS OF THE INTENSIVE LAND USE SYSTEMS AND THEIR CURRENT STATUS IN THIS RESPECT, and if a growing number of people has to be fed,
GP5: INTENSIFY EXISTING INTENSIVE LAND USE SYSTEMS OR INTRODUCE INTENSIVE SYSTEMS AT LOCATIONS OF BEST SOIL, CLIMATE AND MARKET CONDITIONS, SPECIFYING THE AMOUNT AND SOURCES OF NECESSARY INPUTS.

It may be noted that this does not point in a direction of "improving" the existing extensive land use systems, since it is believed that they are already optimally attuned to the needs of those who practice them. Practice shows that the greatest care has to be taken if "improvement" strategies are pursued, e.g., the introduction of new crops, new fishing boats, new cattle types, watering places and the like. Often, total production may rise in favourable years but suffer strongly in unfavourable years. This especially affects the poor who may not have been able to adopt the "improvements", nor will be able to bridge unfavourable periods or invest resources elsewhere. To make matters worse, the increased total yields may stress the production basis above its sustainable capacity. This is especially the case when "improvement" does not result from an increased efficiency, like the meat conversion factor of the cattle. In many arid regions, the introduction of new watering holes is an example of such a removal of a bottleneck from a stable extensive system, resulting in overgrazing and system collapse. Hence, GP5 stresses the need for more fundamental changes, namely, the introduction of new, intensive systems, in which the use of external imputs can be accomodated. The guiding principle does not discriminate between different scales. "Best conditions" may be found at the village, regional or national level.

Furthermore, the objective of responsibility for future generations leads to the well-known imperative
GP 6: KEEP YOUR OPTIONS OPEN,
which, worded in the terms used here, can be specified as:
GP 7: PROTECT, DEVELOP AND USE THE SPONTANEOUS FUNCTIONS OF NATURE (in which 'and use' is in fact derived from the 'efficiency' aim), as well as:
GP 8: TRY TO AVOID LAND USE SYSTEMS INVOLVING IRREVERSIBLE DEPENDENCY ON ONE CROP OR ONE MARKET (ESPECIALLY NARROW AND FOREIGN MARKETS), ALSO ON THE INPUT SIDE (E.G. OIL, CAPITAL AND SPECIAL KNOW-HOW).
The last guiding principle directly connected with the 'future generation' aspect of the 'responsibility' aim lies in the social field, emphasizing that future generations do not live by physical security only, but also on a basis of cultural identity and continuity:
GP 9: PROTECT THE AUTHENTIC EVOLUTION OF LOCAL CULTURE, INSTITUTIONS AND KNOWLEDGE.
This guiding principle links up with many others, derived from all three other aims.

The aim 'efficiency' can be made operative in two directions, concerning the costs and benefits of actions and concerning the incentives for action, representively. The cost-benefit principle gives rise to well-known economic lines of reasoning. For an NCS it may be sufficient to lump them together into one guiding principle:
GP 10: WORK CHEAP,
and to operationalize this in 'ecological' colour:
GP 11: IDENTIFY AND USE 'NEAR-REALIZED' POTENTIALS
(*e.g. adding the one missing nutrient to soil, the one missing* infrastructural link to a region, or the one missing link of products to an economic system),
GP 12: WORK WITH NATURE, NOT AGAINST HER, and
GP 13: LINK UP WITH THE EXISTING SITUATION, E.G. EXISTING INFRASTRUCTURE, TECHNICAL KNOW-HOW, PERCEPTIONS OF LIFE SECURITY, CULTURAL NEEDS ETC.
Examples of local agricultural knowledge with a high sustainability potential are the traditional 'tie ridging' against erosion and the mulching practices.

In Chapter 7 of the Draft Report, GP 12 is elaborated in economic terms, trying to identify which type of economic potential Zambia should develop. There it is stated that development of an agro-industrial complex may be Zambia's most salient 'near-realized potential', also backed up by other guiding principles.

The 'incentives' direction of the efficiency aim will be dealt with later. First, we will pay attention to the stated aim No. 3, freedom. The aim can be made operative by means of the concept of *decision system level.*
By this the following is meant. Social systems can be identified on many different levels, e.g. from the nation, through the province, district, village and (extended) family down to the individual. Depending on their scale, projects and programmes may add some social system level in between. All social system levels carry a certain amount of power, i.e. the choice of act or to influence other social systems towards acting. For any proposed social change of action, it can be identified which social system level(s) is (are) to use its (their) power, that is, which social system(s) level is(are) the decesive system level(s).The desirability of freedom can now be restated as:
GP 14: IN DESIGNING ACTION OR SOCIAL CHANGE, PREFER THOSE INVOLVING THE LOWEST POSSIBLE DECISION SYSTEM LEVEL(S).
In general, this implies a bias towards planning
- bottom-up instead of top-down,
- on the village level,
- involving incentives instead of force
- involving market incentives instead of projects,

while also connections are visible with GP 7, GP 8 and GP 12, derived from quite different aims. Some examples may exemplify GP 14. In some situations, the carrying capacity of a land use system may be exceeded. Then, it may be necessary to leave the system as it is but to design some action to move people out to a better place. GP 13 states that in such a situation a mix of extension and "pulling" incentives (e.g. in free property of new land) is preferable over a centralized "pushing" resettlement scheme.

In another situation the firewood production may need to be increased. Then, if family forest property is not feasible, afforestation programmes should be geared in the next lowest level, i.e. the village.

On the mondial system level, GP 14 takes the form of the concept of 'self reliance'. Against the background of the ever decreasing ratio of Third World product prices against the cost of oil, equipment and capital, for most developing countries this can be specified as:
GP 15: INTEGRATION OF A COUNTRY'S AND A REGION'S RESOURCES (PHYSICAL AND HUMAN) IS THE PREFERABLE SOURCE OF GROWTH.
This guiding principle may take the form of import substitution for strategic goods, application of appropriate technology, regional product clearing houses ('international barter') labour intensive project execution, improvement of the competetive position of the informal sector and the like. The linking of agriculture and industry, following GP 12 fits into this guiding principle as well.

On the level of project design, the selfreliance concept speaks out for a low budget approach, favouring low costs over low cost-benefit ratios and high internal rates of return. Additionally, this approach has the advantage of low risks: costs are relatively stable while benefit estimates are inherently more vulnerable to planner's optimism and market instabilities. Hence:
GP 16: DESIGN PROJECTS IN SUCH A WAY THAT THEY CAN BE EXECUTED STEP BY STEP, UNDER A FLEXIBLE MASTER PLAN.
This project approach can easily be linked up with GP 14 (because of the opportunities for bottom-up strategies), GP 13 (because of the opportunity to link up with the present situation), GP 6 and GP 9 (because a small scale start leaves options open for future use of remaining undeveloped areas).

Many Third World experiences and development authors have drawn attention to the fact that projects and programmes often fail because of the gap between rationality on the project level and on the level of families and individuals. If the latter level is a decisive level (which it often is and should be, according to GP 14), not only the plan as a whole has to be beneficial to society as a whole, but also in the perception of the individual or family. Dey (1982) and Calkins (1982) deal with the problem in two in-depth studies titled 'Development Planning in The Gambia: The Gap between Planner's and Farmers' Perceptions, Expectations and Objectives' and 'Why Development Fails: The Evaluation Gap in Nepal's Subsistence Agriculture'. Hence, the concept of decision system level is not only related to the aim of freedom, but also to the aim of efficiency. For projects to work,
GP 17: IDENTIFY A PLANNED ACTION'S MOST FEASIBLE DECISION SYSTEM LEVEL(S) AND PROVIDE RATIONALITY TO COOPERATE ON ALL THESE LEVELS.
On the family decision level, it is especially the task of the antropologist to understand family motives and perceptions, e.g.
- by indicating which factor(s) determine(s) the perception of life security in a given culture and situation, and

- by understanding the different roles and perceptions of men, women and other groups in the village economy.

Concerning the higher decision system level, it should be investigated why and how departments, local authorities and the like would be motivated to implement the plan. The plan should be designed in such a way that benefits arise on all decision system levels implied by the plan. If this cannot be provided, the plan should be redesigned, either by shifting benefits towards the level where they are missing, or by shifting the decision system level the plan needs for implementation.

Guiding principles derived from the aim of harmony and justice are partly opposed to those derived from the aim of freedom. The emphasis one lays on these aims and the way their opposition is organized gives rise to the well-known political views of socialism and liberalism, but also less known ordering principles for society like Rousseau's social contract. For an NCS, the aim might be specified as:

GP 18: PROTECT AND DEVELOP A BALANCE OF POWER, INCOME AND KNOWLEDGE BETWEEN REGIONS, BETWEEN CLASSES AND BETWEEN THE URBAN AND RURAL AREAS.

In our study, this aim has not been elaborated further, but has instead become a part of the design method. This has the following background. In Zambia, many regional differences, class differences and the urban-rural differences become visible in one structure: the opposition between the 'centre' (line-of-rail, Lusaka and Copperbelt) and the periphery. The remaining differences, e.g. class differences within the 'centre' or tribal differences within the periphery, seem to us less directly NCS-relevant.

Then, the aims of harmony and justice can be made operative if "regional planning" is explicity incorporated in the design process, independent of planning on the national system level. The final plan can then be designed to contain a large number of options which draw their rationality from regional optimizations and benefits.

The next paragraph shows this procedure.

Naturally, we do not claim that this approach operationalizes all relevant social contradictions in Zambia. For other countries, where division may occur along completely different lines, other planning approaches may have to be found.

List of guiding principles:

GP1: Protect the rare species and ecosystems in their authentic ecological setting, taking into account the long term effects of isolation.

GP2: In planning protection areas for species or ecosystem protection, try to make them as large, diverse and interconnected as possible.

GP3: Assess the carrying capacity of the extensive land use systems and their current status in this respect, and

GP4: Assess the input requirements of the intensive land use systems and their current status in this respect, and if a growing number of people has to be fed,

GP5: Intensify existing intensive land use systems or introduce intensive systems at locations of best soil, climate and market conditions, specifying the amount and sources of necessary inputs.

GP6: Keep your options open.

GP7: Protect, develop and use the spontaneous functions of nature (in which 'and use' is in fact derived from the 'efficiency' aim), as well as:

GP8: Try to avoid land use systems involving irreversible dependency on one crop or one market (especially narrow and foreign markets), also on the input side (e.g. oil, capital and special know-how).

GP9: Protect the authentic evolution of local culture, institutions and knowledge.

GP10: Work cheap.

GP11: Identify and use 'near-realized' potentials.

GP12: Work with nature, not against her, and

GP13: Link up with the existing situation, e.g. existing infrastructure, technical know-how, perceptions of life security, cultural needs etc.

GP14: In designing action or social change, prefer those involving the lowest possible decision system level(s).

GP15: Integration of a country's and a region's resources (physical and human) is the preferable source of growth.

GP16: Design projects in such a way that they can be executed step by step, under a flexible master plan.

GP17: Identify a planned action's most feasible decision system level(s) and provide rationality to cooperate on all these levels.

GP18: Protect and develop a balance of power, income and knowledge between regions, between classes and between the urban and rural areas.

1.4. OUTLINE OF THE APPLIED NCS DESIGN METHOD.

A planning and implementation process consists of many steps, phases and feedbacks. Concerning the NCS of Zambia, IUCN(1983) may be referred to in this respect. In our study, we have focussed completely on the core of the planning proces, i.e., the design process proper, as stated in the preface. In a general way, design may be defined as *a synthesis of potential plan elements (options) into a system of plan elements (a plan), guided by the psycical and social characteristics of the problem situation and by guiding principles, being the operationalizations of conflicting aims and objectives.*
Many more or less formal methods are available for design, e.g.,
- the formulation of patterns - of - consistent - plan - elements (compatibility analysis)
- formal land evaluation methods, supported by "sieve analysis" steps etc.
- 'analysis of interconnected decision areas' (AIDA) and other computerized algorithms of permutating options
- simulation models, like those used in 'computer aided design' (CAD)
- the automatic optimizing procedures of 'linear programming'.

Potentially, these formal methods yield superior results, especially when used in combination with more informal, creative inputs. However, to realize these potentials, massive data sets are required and much time is consumed by formalizing and 'computerizing' the designer's qualitative insights, implicit knowledge, the vagueness of his quantitative knowlegde and his creative, synthesizing power. Therefore, many design strategies are of a more qualitative, informal and implicit kind. Consider, for instance, the way in which an architect designs a house. He uses many quantitative data and methods together with qualitative insights in a cyclical design process in which a soft pencil and heaps of draft-paper play an important role.

Essential to all design methods is a certain degree of cyclicality. In highly cyclical strategies, all design steps are visited several times, in a process of constant reformulation. In more 'linear' strategies, the steps may be visited only once, leaving cyclicality within the separate design steps only, implying for instance, that all inventory and analysis is done before the design proper takes place. In general, the highly cyclical strategies tend to be more efficient while the more linear methods tend to be more effective (ref. De Groot, 1984 and Jones, 1970). The method applied in our study is of a rather linear type. Retrospectively, a more cyclical approach might have been preferable. A 'pre-design' exercise earlier in the study period might have given more direction and selectiveness to the data gathering steps.

In view of the data requirements of formal methods on a national scale, the research time available and the objectives of our study, accepting a largely qualitative, 'architectural' design method has been deemed more feasible than trying to apply a formal method in some necessarily rudimentary way.

As a background of the design method expounded below it is necessary to explain three concepts first:
(1) the degree of 'integration' in a plan:
(2) the scale of a plan as an expression of the plan's degree of detail;
(3) the scale of a plan as an expression of the 'scale of the plan's rationality';
Underneath these concepts are worked out in this sequence.

(1) Any plan must take into account all relevant objectives of a society and all aspects of the physical and social situation pertaining to those objectives. Without this, a plan runs the risk of being utopian.
This holds for an NCS, which has to take into account social bottlenecks, economic constraints, agricultural potentials and the like, as it holds for any other plan, e.g. a tourism development plan or a national education strategy. On the other hand, incorporating objectives in a plan can be done in a varying degree. For instance:
- some objectives can be 'allowed' to actively generate potential plan elements, while others remain passive;
- some objectives can be given a relative overweight in the selection of potential plan elements and plan alternatives.

The more objectives play an active role in the design process and the more balance is claimed concerning the weight given to objectives, the more a plan can be called 'integral'.
The less this is done, the more a plan can be called 'sectoral'.
In general, the more sectoral a plan is, the more it represents a reduced rationality, but the easier it is to be designed.

(2) Plans can be made on different scales, e.g. on a village or project level, a regional level and a national level. This scale may simply be an expression of the degree of detail in a plan. Then, a detailed plan is only a local elaboration of a higher-level plan, without a shift in objective or point of view.

(3) However, a planning scale may also express something more fundamental:
the project rationality vs. the national rationality, the regional point-of-view vs. the national point-of-view, and the like.
Two examples may clarify this. On a project level, the national decision level may only exist in the form of a budget given to the project. In a project rationality, this budget must be spent in a way to get the most out of it in terms of output, no matter whether inputs are imported or locally made, whether the production is capital intensive or labor intensive, whether regional balances are disturbed or strengthened etc.

These aspects are only visible on a higher scale or decision level. Parallel differences hold on the local vs. the regional and the regional vs. the national level. For instance, subsistence agriculture and a need for a balanced non-marketed food supply are clearly visible on the local level, while the 'national rationality' will tend to allocate production factors on a nation-wide scale, working from a national market and a national efficiency perspective. Especially in developing countries, a neglect of individual, local and regional perspectives may result from this 'National efficiency'. As said before, this may severely hamper the plan's implementation.

Theoretically, national plans can incorporate all relevant regional perspectives, while regional plans can reflect all aspects of national rationality. In practice, such a 'double focus' is difficult to realize in one design step. National plans will always tend to implicitly emphasize rationality on the national system level. In the case of Zambia this may mean: national integration and efficiency, but also sharpening of the existing imbalances of the dual economy and the centre-periphery complex. Regional plans will implicitly tend towards the contrary: rural self-reliance, smaller scale projects for regional use etc. If those regional plans are simply put together in order to cover a whole nation, on that national scale a picture arises of industrial diversification, short-distance transports, cultural diversity less top-down approaches in projects, less massive migration to national centres, but without interregional specialisation, large-scale biosphere reserves and the like.

Originally, it was thought that our NCS design method should adopt the following line:
(1) Make a rough, but integral 'pre-plan' on a national scale.
(2) Test the completeness and rationality of this plan by working out one or more regional plans 'underneath' the national pre-plan.
(3) And use this experience in improving the national pre-plan and formulating the definitive national plan.
This 'Inzoom-outzoom method' has posed problems:
(1) It desires a one-step formulation of an integral plan on a national scale. It is very hard to keep track of the risks that such a plan would implicitly be too sectoral and that too little regional rationality would be incorporated.
(2) The method needs one or two integral plans on a regional scale which, if the national level pre-plan is to be tested through it, should be quite detailed and explicit. This may require a lot of time, while the NCS does not need such detail.
(3) If the regional plans implicitly incorporate much of the national level rationality, it will turn out that they will not have a testing power. They add detail only, not a conflicting perspective.
(4) Even if the regional plans turn out to be a test of national vs. regional rationality, how could that experience be translated into the national plan for all regions not planned on the regional scale? Would it not be necessary to make detailed regional plans for all the nation's regions?

In view of the requirements of an NCS and the time available to the research team, we constructed and applied a method which might be called 'Integrate Reduced Rationalities' (IRR, IRRelevant?IRRational?)

First of all, design of regional plans has been deemed a necessity,
- for environmental reasons: many environmental problem potentials only become visible on a regional scale of detail (land use systems, soil types etc.).
- for strategic reasons: to make sure also regional rationality will play a role in the national plans.
However, it has been accepted that in designing these regional plans, only the regional rationality must compulsory be incorporated. The main advantage of this reduction is the design speed. Since complete rationality will be taken care of later, a designer (or multidisciplinairy design team) will be able to make the necessary 'creative design jump' relatively undaunted. In designing the regional plans, because of their relatively concrete character and scale, it has been thought possible to make those plans *integral*, i.e. incorporating all NCS-relevant objectives (sectors) on the scale in one step. Then the national systems level rationality is approached in an equally reduced manner: *sectoral* plans on that level are designed, without compulsory reference to either the regional level or intersectoral (integral) coherence. Again, because of their 'primitive' character, these plans can be made relatively quickly.

As the last step, all plans (implicity, their different rationalities) are confronted with each other, location by location and proposal by proposal. In this process, a national integral plan takes shape.

More specificly, the method consists of the following steps:

(1) *Define regions*, making arbitrary boundaries in a manner guided by the following principles:
- the region should be large enough to become potentially a diverse, integrated, self-reliable economic entity;
- the region should be small enough to make environmental problems and local differences clearly visible on the map;
- the region should be homogeneous enough with reference to land use systems and place in the national economic structure, e.g., boundaries could run through sparsely populated areas;
- the region should be small enough for the designer to grasp all problems, potential plan elements etc., in one view, so that a synthesis becomes possible without formal interim steps.
In our study, Zambia has been divided into 6 regions in this way.

(2) *Without compulsory reference to rationality on the national level of interregional 'boundary rationality' design separate but integral regional plans*, after having analysed the regional problems, potential and potential plan elements, guided by the NCS guiding principles. The result of this step are six separate plans, in which a twofold reduction in rationality may be implicitly incorporated.
- it has been tried for the regions to solve their own problems and realize their own potentials; the national problems, potentials and economy is only incorporated in a passive way, e.g., as a market 'abroad' only;
- boundary relations with other regions have not been looked into.
In the third step, only the latter reduction is tackled.

(3) *Erase the arbitrary regional boundaries,* by checking for irritationalities and impossibilities across the boundaries. For instance, if an area is to be isolated at the south of some boundary and to be developed at the north of that boundary, some choice has to be made.
The result of this step is a plan on a national scale, but still possibly including irrationalities on the national economic level. It is 'the NCS of the Zambia-of-regions', as a design tool as well as a counterweight for a centralistic, top-down approach.

Generally, every regional design will implicitly take into account some amount of national level rationality. For instance, not every region will have its own international airport, its own bicycle factory or complete food self-sufficiency. On the other hand, some problems and potentials will only be visible on the national systems level. The next design step takes care of this:

(4) *Without compulsory reference to the potentials within regions, design separate sectoral national plans for all NCS-relevant sectors.*

In our study, sectors like 'commercialization of agriculture', 'forestry' and 'nature conservation' have been chosen. The plans have been called 'views' to indicate that we have not been able to give them much empirical grounding. Essentially, however, these sectoral plans indicate what should be done where, in order to do things on a nationally most efficient way within each sector.

Analogous to the regional design steps, a next step could be to 'erase boundaries' on the national level, that is, integrating the separate sectors. This has been deemed less functional. The reason for this is twofold. First, practice shows that many countries do not make national overall-plans themselves; the sectoral plans remain separate and conflicts between them are tackled at the moment when concrete decisions have to be made. Secondly, in our next design step all regional plans are confronted with the sectoral plans, so that possible conflicts between sectors show up automatically on that scale. Hence, the fifth step:

(5) *Confront the results of step (3) with the results of step (4),* i.e. 'the NCS of the Zambia-of-regions' with the separate sectoral plans. In this step, two things take place at the same time: choices between the two levels of rationality and choices between sectoral views. These choices, however, are not of a general kind, but concentrate on concrete points of conflict. Consider, for instance, an area in which sector A wants to do activity X and sector B wants to do activity Y. If then, the regional plan proposes X, that activity may be chosen. If the regional plan proposes activity Z, a more fundamental (albeit area-specific) discussion has to take place.

In this way, the 'regional-integral' and 'national-sectoral' rationalities are integrated into a potentially balanced and complete 'national-integral' NCS.

This chapter is mainly based on chapters 2, 3, 4 and 5 of the Draft Report and on Bont & V.d. Voort 1986. It gives a very short description of the inventory and analysis we have made of the Zambian situation, which we needed as a basis for planning our NCS.

2.1. PHYSICAL BASIS.

Zambia consists mainly (80%) of a series of flat or gently undulating plateaus, largely between 900 and 1500 m in altitude. Plateaus at different levels either merge gradually or are separated by escarpment zones (12%) and rift valleys (6%) (Fig. 1).

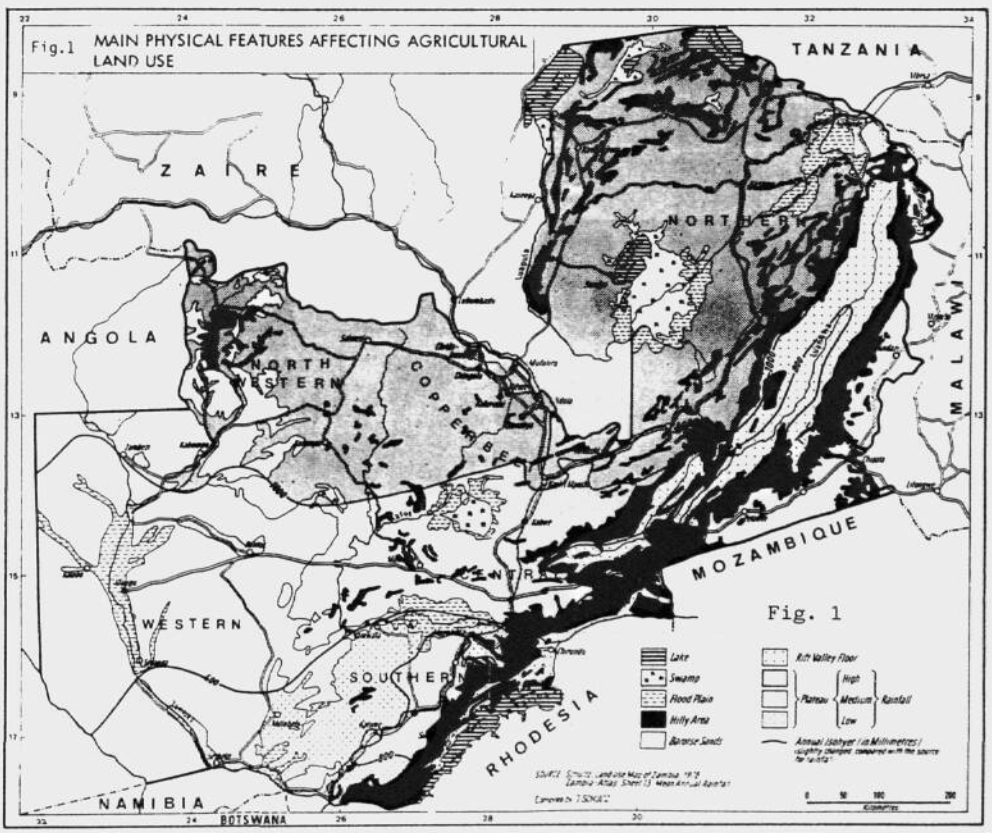


Fig. 1

The remaining area, 2%, is occupied by lakes, of which Lake Mweru, Lake Tanganyika, and the "manmade" Lake Kariba are the most important.

Zambia has a tropical plateau type of climate with marked wet and dry seasons. The temperatures are moderate, because of the altitude and a relatively dense cloud cover during the summer months.

season	month	characteristics
rainy	mid-Nov.-March	hot & wet
post rainy	April	mainly dry
dry winter	May-September	cool & dry
hot	October	hot & dry

The wet season shows, going from north to south, a decrease of both mean annual precipitation (1500 mm - 600 mm/year) and of the length of the wet season (190 - 120 days), and consequently the length of the growing season. The variability of rainfall is highest in the south, which gives high cropping risks. Fig. 2 gives the zonation of Zambia in semi-arid, sub-humid and humid. The sub-humid zone has the best moisture conditions for agriculture. There is marked seasonal fluctuation of river discharge. Many of the smaller streams dry up in the dry season, especially in the south, where less surplus water is available. In the larger rivers, minimum flow may be less than 1% of maximum flow.

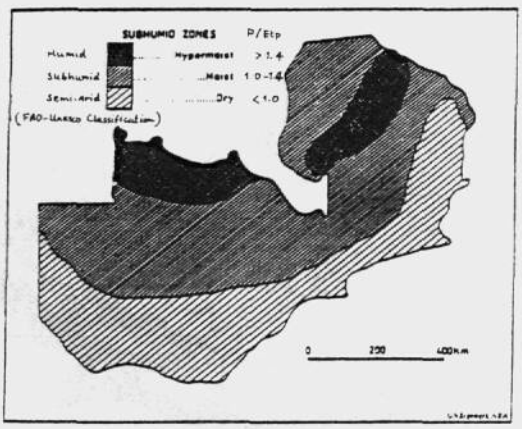


Figure 2. Pricipitation/evapotranspiration (potential)= P/Etp zones. Calculated according to the Penman method. (source: Chidumayo in Davies, 1971).

On many plateaus, the low gradients have caused permanent flooding of swamps and seasonal flooding of floodplains, dambos and areas surrounding swamps. The edges of floodplains (like Kafue Flats and Barotse Plains), dambos and swamps become the favourite human settlement sites (Verboom, 1982) because of the initial fertility of the soils and the availability of water, game and trees.

The soils and soil potentials are given on Map 1. This map gives 33 soil descriptions (and their natural vegetation). It also gives the potential productivity of those soils for agriculture, and their erosion risks. This map is strongly generalized. If compared with the more detailed maps of Northern Province from Lange & Mansfield (1975), many soils which are given here as generally suitable for agriculture are in fact less generally so, for instance because of the frequent occurence of rocks.

2.2. The Biotic Basis.

Zambia lies entirely within the Sudano-Zambesian phytochrological region. This is a floristically very rich region. Typical vegetations are woodlands and savannes (Werger, 1978). Other important vegetation types are termitaria and grasslands (mainly on floodplains, dambos and near swamps and rivers).

Because of biotic and human activities (grazing, cutting, burning, etc.) many of these vegetationtypes have merged into other, secondary vegetation types (regression). Regeneration also takes place; many land use systems are based on this regeneration of woodlands, e.g., chitemene (shifting cultivation type) and several semi-permanent hoe (and ox-plough) cultivation systems. Woodlands are also used as a source of timber, firewood and charcoal. Grasslands are

mainly used for cattle keeping. Especially on floodplains and dambos their productivity can be high. Plateau grasslands, which are needed when the floodplains and dambos are flooded, have a very low productivity.

One of the most important animals of Zambia is the tsetse fly. It is the transmittor of the bloodparasite Trypanosomas, which causes the cattle disease trypanosomiasis, or the human "sleeping sickness".
All tsetse flies feed exclusively on blood, and require the shade of tree cover. Tsetse fly belts cover approximately two fifth of the country, ref. Fig. 3. They are more or less static, but there is growing risk that the fly infestation may spread to other areas. One of the main causes of spread is the practise of keeping too much cattle on the grazing grounds (Storrs, 1968). Wild animals play a role as a reservoir of the parasites. Those animals have reached a certain immunity.

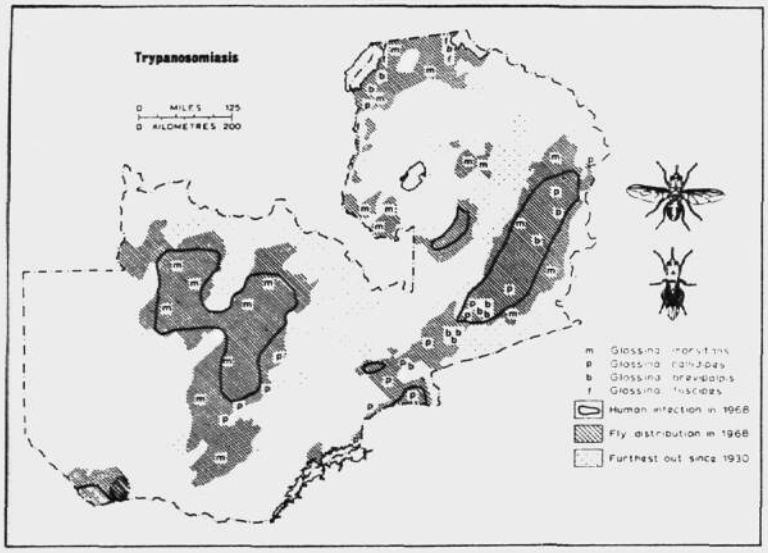


Figure 3. Trypanosomiasis (source: Davies, 1976).

Other important animals in Zambia are fishes. The Ichtyofauna is well developed, because of the occurence of several large lakes and major river systems, combined with the wide diversity of habitat. Fish plays an important role in the food pattern of Zambian people.

Well over 100 species of mammals occur in Zambia (Speece, 1982), many of them have had their ranges reduced, but none of them has become extinct in modern time Zambia, although some of them are endangered. They are relatively 'safe' in the National Parks and Game Management Areas (32% of Zambia), where only some restricted human activities

are allowed. However, wildlife is threatened nowadays by poaching, burning, hunting and use of pesticides for tsetse control.

2.3. The Agro-climatic regions.

The main agro-climate regions, which are defined by temperature, precipitation and moisture conditions, are shown in Fig. 4. Their characteristics may be summarized as follows.

Region I.1. Heavely leached soils.

High water surplus and long growing season, favours annual crops or varieties with a long graving season and which are resistant against rust and fungal diseases.

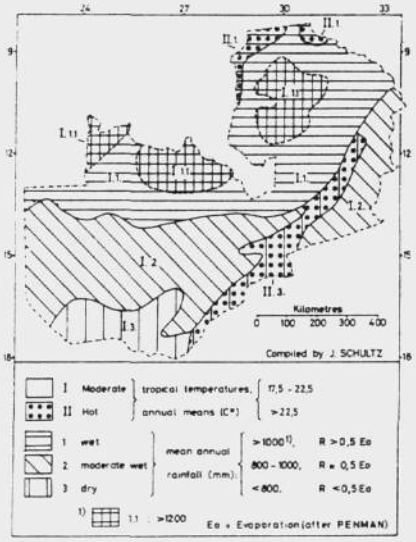


Figure 4. Agro-climatic zones.
(source: Schultz, 1976).

At the moment, perennial cassava is the major subsistance crop. Other crops are sorghum, finger millet and maize.
Most likely, tree crops like fruit trees (citrus) and timber trees would also do well (Mansfield, 1975). Maize and groundnuts, despite their high cultivation frequency and acreage, do not yield as much as further south in the I.2. region, under similar soil conditions. Cotton grows very poorly.

Sub region I.1.1.

Those wet regions are found within I,1 and have the longest growing season of the country. Perrennials like pineapple, coffee and tea are cultivated as Government scheme. The yield increases significantly when some additional irrigation is applied during the dry season.

Region I.2. Less leached soils.

Growing season: November-March. Somewhat larger cropping risk because of greater frequency and length of dry spells. Night frosts can limit the use of fruit trees in the South-West. This climate is quite favourable for varieties of annual crops with short growing periods. Soils can limit the potential for cropping, especially on the

Barotse Sands (Western Province). The main crops are: maize, cotton, tabacco, cassave, groundnuts and bulrush millet.

Region I.3. Semi arid region.

Soils are almost not leached, because annual rainfall is limited, and evaporation is high. Mean duration of growing season: December-March. The risk of dry spells is high, and favours drought resistant crops like sorghum, or those with a short growing period like short-term varieties of groundnuts. The effective rainfall is marginal for maize. In general, timber production (Bailinea pluryuga) and cattleraising provide more profitable types of land use than cropping.

Region II.1. Tropical, hot and wet region.

The high temperatures permit the growth of oilpalms, mangoes, pawpaws and bananas. Other crops with high potential might be paddy rice and perhaps cashew nuts. The main staple crop is cassava; maize and groundnuts are co-dominant.

Region II, 2. Tropical, hot and dry regions.

The dry climatic conditions and mostly poor soils offer little potential for agricultural use. Under the conditions of rain-fed farming, drought resistant crops like sorghum and bulrush millet have gained a relatively strong position among the staple crops. Maize is the only other staple crop grown to any extent. Cotton is probably the only cash crop of dry land farming. Potential crops under irrigation are: Tropical crops (e.g. bananas), rice and vegetables. They can be grown successfully, but probably unremunetarive.

2.4. THE LAND USE SYSTEMS OF ZAMBIA.

Traditional land use systems.

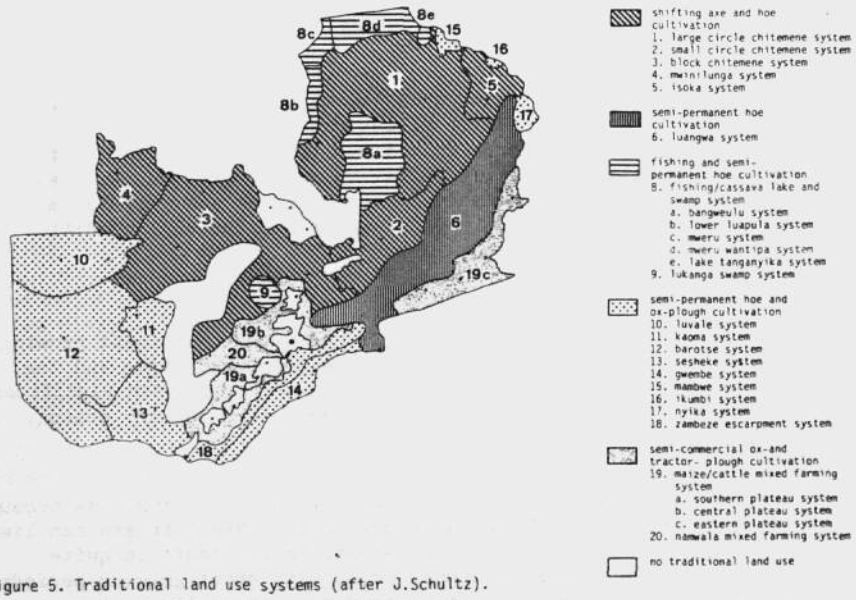


Figure 5. Traditional land use systems (after J.Schultz).

The basically traditional land use systems (shown in Fig. 5) encompass those systems in which agricultural practices are largely based on local tradition, and in which traditional (tribal communal) rights to land still exist (although changes towards individual rights to land, at least as far as cropland is concerned, are visible everywhere). The systems are adaptations to various physical and cultural environments. Their main characteristics are: small scale, non-intensive, relative low yields per capita and unit area worked, subsistance, little capital input or use of modern techniques. Each system is a mixture of various activities (cropping, food processing, hunting and gathering), although there is usually an emphasis on one activity. In Zambia 66% of the total population is occupied with traditional land use (Schultz, 1976). Traditional crops are cassava, sorghum, millet.
According to Schultz (1976), the land use systems can be classified as:

- Shifting axe and hoe cultivation (chitemene)
- Semi-permanent hoe cultivation
- Fishing and semi-permanent hoe cultivation
- Semi-permanent hoe and ox plough cultivation
- Semi-commercial ox and tractor plough cultivation

For association with tribes and population densities see Fig. 6.

Ref. No.	Land use system	Main tribal groups	Population density (pers./sq.km.)
1.	Large circle chitemene system	Bemba	8.8
2.	Small circle chitemene system	Lala	5.6
3.	Block chitemene system	Lamba, Kaonde	17.6
4.	Mwinilunga intermediate shifting/ semi-permanent cultivation system	Western Lunda	18.7
5.	Isoka mixed large circle chitemene/ cattle system	Iwa, Inamwanga	8.6
6.	Luangwa system	Senga, Bisa, Kunda, Ambo	45.7
7.	Subsidiary garden system of urban employees	pluralistic	-
8.	Fishing/cassava lake and swamp system:		
	a. Bangweulu system	Unga, Bisa, Mukulu, Ngumbo, Lala	56.8
	b. Lower Luapula system	Eastern Lunda	39.7
	c. Lake Mweru system	Bwile, Shila	87.7
	d. Lake Mweru Wantipa system	Tabwa, pluralistic ?	86.8
	e. Lake Tanganyika system	Lungu, pluralistic ?	81.3
9.	Lukanga swamp system	Batwa, pluralistic ?	21.1
10.	Luvale system	Luvale, Luchazi, Chokwe	24.6
11.	Kaoma system	Nkoya	20.8
12.	Barotse system	Lozi	29.5
13.	Sesheke system	Titela, Toka	26.8
14.	Gwembe system	Valley Tonga	47.3
15.	Mambwe system	Mambwe	22.5
16.	Ikumbi system	?	20.6
17.	Nyika system	Nyika, Fungwe, Yombe	12.7
18.	Zambezi escarpment system	Tonga	39.8
19.	Maize/cattle mixed farming system:		
	a. Southern PLateau system	Plateau Tonga	25.5
	b. Central Plateau system	Lenje, Soli, Sala, pluralistic ?	31.1
	c. Eastern PLateau system	Nsenga, Ngoni, Chewa	23.0
20.	Namwala mixed farming system	Ila	48.2

Figure 6. The land use systems and their tribal assotiation and populationdensity. (source: Schultz, 1976).

Commercial agriculture and cattle breeding.

Within the commercial production structure of Zambia, three categories of producers can be distinguished, according to their production scale, ref. Fig. 7.

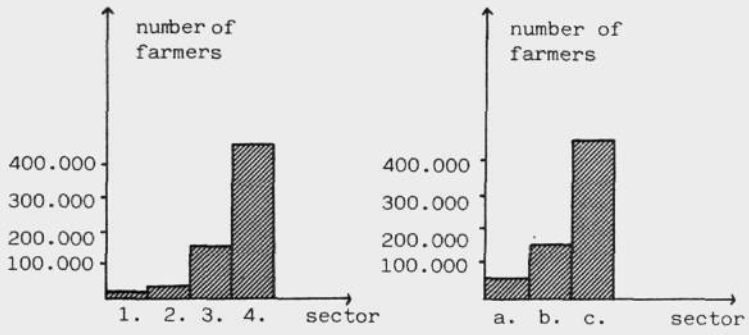


Figure 7. Agricultural production structure.

1. large scale commercial producers. } a.
2. medium scale commercial producers. }
3. small scale commercial producers. b.
4. subsistance producers. c.

Large scale commercial producers can be found along the line of rail. They make use of high input technologies and hired labour, producing for maizes, cities and export. Cash crops, such as high yielding varieties of maize and tobacco are the most important products. Medium scale commercial producers use commercial technologies which utilize animal draught power, to a large extent. These farmers market practically all their production. They rely largely on family labour. The small scale commercial producers, also called emergent farmers or semi commercial farmers, on average still rely to a significant extent on hand cultivation methods. They use improved seeds and substantial quantities of fertilizer.

There are ten main food crops in Zambia: Maize, sorghum, millets, cassava, rice, wheats, pulses, groundnuts, sunflower and soyabeans. These ten crops cover an area of 1.400.000 ha. More than half of this area is under maize. In the line of rail area more than 60% of all agricultural output, including subsistence output, is produced, although only 32% of the rural population lives in these areas including almost all of the commercial farmers. For commercial cattle breeding see Fig. 8.

Forestry.

Nearly 460.000 km² of Zambia (60%) is classified as forested, although the major part of this area is actually woodland. They are mainly utilized for:
- woodproduction (timber, firewood, charcoal)
- natural nutrient resource for shifting cultivation
- forestry by-products (beewax, honey).

Not all used wood is indigeneous. Some plantation exists, mainly of Eucalyptus species and tropical pines. Eucalyptus are used for fencing, telephone and other poles and for box wood and processed boards. Pines are mainly for structural general purpose and mine timbers.

Fuelwood comprising firewood and charcoal, is the non industrial energy source in Zambia. It is traditional household energy source. It is assumed that fuelwood is utilized because it is presently available and because it is the cheapest fuel on the market (Chidumayo, in press).

Industry, mining and infrastructure.

Zambia is rich of minerals. It possesses copper, lead, zinc, gold, silver, coal, limestone and dolamite. There are plans to mine iron and uranium. The copper and cobalt reserves are respectively 6,0% and 7,6% of the total world reserves. Most mines are in the Copperbelt.

Industry is situated in the line of rail area. The infrastructure is also best there. For detailed information see MAP 2.

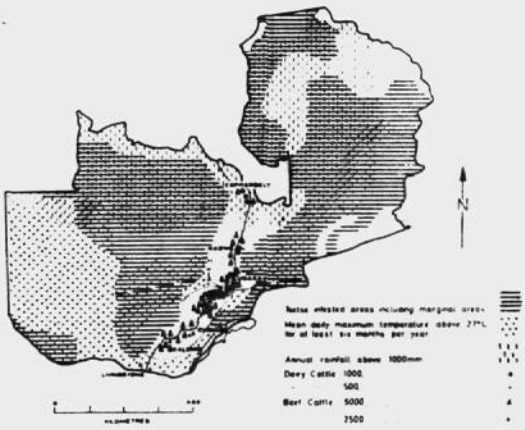


Figure 8. Distribution of cattle in the commercial sector in Zambia.

2.5. Environmental Problems in Zambia.

Zambia's main environmental problems are indicated on Map 3. They are classified as:

- degradation of the soil, by wind-erosion, water-erosion and depletion of nutrients
- degradation of the vegetation, due to deforestation and rangeland mismanagement
- loss of wildlife and natural ecosystems
- air, water and soil pollution.

The first two types of problems are a direct threat to the life basis of the rural areas and the food supply of the country as a whole. The last two types are more closely linked to man's responsibility for nature and for future generations.

As may be seen on Map 3, soil erosion is a feature of especially the commercial agriculture areas and the escarpment regions.

In the real NCS for Zambia momentarily being made by the Zambia government in cooperation with the IUCN, the deforestation problem will be covered extensively, as far as we know. Therefore, in this paragraph we will analyse two other environmental problems: depletion of soil nutrients and rangeland degradation. As the deforestation problem, both give rise to irreversible processes, fundamentally affecting the very roots of Zambian society.

Soil nutrient depletion in shifting agriculture.

In Zambia's Northern Province, a large part of the arable land is used by two main systems of 'shifting axe and hoe cultivation', the large circle chitemene system in the south (Schultz 1976). At the moment, these land use types can hardly expand anymore, since most of the potentially suitable land of the area is already involved. The average population density is very low, but steadily increasing. The carrying capacity of the systems are also low, because of the fact that no external nutrients are added and the soils are basically poor in nutrients. The latter is due to the soils texture and the high rainfall, causing rapid leaching of the soil. Table I summarizes the situation.

Table I. Critial population density (Carrying capacity) and actual population density of the chitemene land use systems in Northern Province. Source: Bont en Van de Voort (1986), compiled from Lang & Mansfield (1975) Schultz(1976) and the Zambia Census of 1980. Population densities are in numbers of people per km^2.

Land use system:	Large circle chitemene	Small circle chitemene
Critical population density, present situation:	1.7	1.3
Critical population density, if all probably suitable land were used:	2.7	2.1
Actual population density, 1969:	3.7	2.4
Actual population density, 1980:	3.9	2.5

Comparing the critical and actual population densities, it becomes clear that the carrying capacity of both land use systems is exceeded. This indicates that one, or both, of the following processes is taking place:

1) if enough male power is available to keep up the forest clearing activity, the follow periods will be progressively shortened and the system will collapse in an ever increasing rate, due to soil exhaution;
2) if males have migrated to town, the chitemene circles will be worked for too long a time to remain productive; then, no immediate collapse is immanent but people will either suffer from impropriate diet or the region will have to turn to "living off" other regions, buying food with the money earned in the urban areas.

In some areas of Northern Province, fish was available or cattle could be kept. In these areas, people have been able to shift away from the chitemene system and develop semi-permanent systems of a mixed character. In these systems, the protein-rich millet of the chitemene system is largely replaced by cassava, that contains hardly any protein, but increases the carrying capacity. This capacity is further enhanced by intercropping with nutrient fixators. The protein is then provided by cattle or fish. Table II summarizes the situation of these systems.

Table II. Critical and actual population densities of the mixed land use systems in Northern Province. Source: as in Table I. Population densities are in numbers of people per km^2.

Land use system:	Bangwenlu system	Lower Luapule system	Mambwe system	Nyika system
Critical population density, present situation	9.3	47.3	30.9	14.0
Critical population density, if all probably suitable land were used:	22.9	76.3	46.9	18.0
Actual population density, 1969:	6.6	15.0	12.4	5.4
Actual population density, 1980:	7.2	16.3	13.1	5.7

Comparing the critical and actual population densities in Table II it becomes clear that these systems are in a stable state and even have some possibilities left to expand their area, if enough labour is available or labour productivity is raised. It should be born in mind, however, that these systems are confined to specific areas with rather good conditions regarding the presence of large surface water areas, flood plains, dambos etc. With this background, Schultz(1976) regards cassava gardening within a chitemene area as indicative for the beginning of chitemene breakdown. People shift from millet to cassava to keep up their calories intake, but have no compensating protein source.

Problems comparable with the chitemene over-exploitation occur in other parts of Zambia, although not on that scale. According to Schultz(1976), in Northwestern Province there may be some place left for expansion.

Apart from soil exhaustion, over-exploitation of shifting cultivation systems causes soil erosion and deforestation. Generally, in

Northern Province the exhaustion feature prevails.

Rangeland degradation.

Cattle are kept in many land use systems in Southern and Western Provinces. Chidumayo (in Johnson and Roder, 1979) records an average gross stocking rate of 1.1 acres (0.44 ha) per lifestock unit (L.U.). Excluding hilly country, national parks and forest areas, the stocking rate is 0.8 acres/L.U. These rates are very high if compared with the recommended rate of 12.5 acres/L.U., indicating that overgrazing is taking place. In Table III, the actual cattle densities and carrying capacities are compared more specificly.

TABLE III. *Actual stocking rates (acres available per lifestock unit) and carrying capacities (acres necessary for sustainable use without fertilizer) per lifestock unit.*

	actual stocking rate		necessary stocking rate
Western Province			
Western Province uplands	not av.	.....	40
Western Province floodplains, 1977**	8.3	.....	10-20
Western Province dambos	not av.	.....	20
Soutern Province			
Reserves (upland and dambos), 1977*	2.5	.....	10-20
Kafue Flats region upland, 1982**	3.2	.....	12
Kafue Flats region floodplain, 1982**	5.2	.....	10
(Kafue Flats region dambos not significant)			
Eastern Province			
Eastern Province upland and dambos, 1977*** (no significant floodplains)	5.5	.....	10-20
North Western Province			
Kabompo system (all tsetse-free ecotopes), 1973*	532	.....	20-25
Zambesi system (upland and dambos), 1973*	197	.....	20-25
Zambesi system floodplain, 1973***	70	.....	20

Northern Province		
Isoka system upland ***	10	 25
Isoka system floodplain ***	30	 20
(dambos not significant)		

* : directly known from literature
** : calculated from known cattle numbers and area
*** : calculated from known cattle numbers and estimated area

Source: Bont & Van de Voort (1986), compiled from Schultz (1976), Verboom (1982), Johnson & Roder (1979), Johnson (1980), Min. of Agr. and Dev. (1983), Verboom & Brunt (1970).

This table indicates that the carrying capacities of the rangelands are exceeded except for North-Western Province and the Northern Province floodplains. The latter areas, however, have an annual rainfall exceeding 1000 mm. Because of this, woodland is favoured over grasses and the area is much less suitable for cattle than the figures suggest.

In the upland, young grass shoots grow quickly at the onset of the rainy season. These are mainly perennial grasses and some quickly germinating annuals. As the grasses mature, their nutritional quality decreases. At the end of the rainy season maximum biomass is reached. In the floodplains, grasses usually have a better nutrient status, except for phosphorus (Verboom & Brunt, 1970), and follow a different growth cycle. They start growing when the flood waters subside i.e., after February in the North and after April in the South of the country. In a cattle system with only upland ranges, the dry season is the bottleneck. In a cattle system which includes a floodplain, the bottleneck may occur either at the end of the floodplain period or at the end of the upland period, depending on the timing of the floods and the ratio of floodplain and upland productivity, i.e., the relative floodplain size.

Bottlenecks in the cattle food cycle may be alleviated by using maize stalks after harvest (about May) or special fodder crops, like browse trees.

The carrying capacities of rangeland are influenced by burning and overgrazing. Underneath, we will briefly discuss these two activities, based upon Bont & Van de Voort (1986), Werger & Coetzee, in Werger (1978); Werger & Colaris (1975), Fanshawe (1971), Kessler & Ohler (1983) and Geerling (1980).

Fire has always played an important role in the woodlands, savannas and grasslands of Africa. Originally it was a climatological factor, but nowadays burning has become a human tool in managing the vegetation cover. Most vegetation types are burnt now at least once a year, to stimulate young grass growth, to remove grass litter, and to rouse

game for hunting. It also takes place for land clearing combined with cutting. Together with termites fire is the most important decomposition factor of dead plant material, doubling the decomposition rate. However, a large part of the minerals (N, C and S) are lost.

Three types of burning can be distinguished (1000 kg/ha of dry plant material necessary):

- Early burning (burning at the start of the dry season). Because the herb layer is not very dry, the fire stays low, and the temperature is low. This fire is beneficial for trees; they are not harmed.
- Late burning (burning at the end of the dry season). Intensive fire because the herb layer is completely dried out. Trees can die, beneficial for grasses.
- Burning early in the wet season. Very destructive because many plants are physiologically active, and very sensitive for fire.

Late burning takes place for rangeland management. It favours monocotyledoneae (i.e., grasses) above dicotyledoneae. Daubenmire (1968 op.cit. Rutherford in Werger ed., 1978) states, that in Africa, regular burning increases production in relatively moist (more than 850 mm/year) regions, but is generally detrimental in more arid regions (less than 650 mm rainfall per year). In medium rainfall areas no effects of burning on the productivity may be expected. In moist areas, however, removal of material through mowing can enlarge the productivity more than removal of material through burning (Rutherford in Werger ed., 1978).

The environmental effects of burning concern both soil and vegetation. Burning leads to the loss of nitrogen, stored in plants, through oxidation, and increased leaching of other nutrients.
Burning late in the dry season may have the effect of making the soil susceptible to water erosion if the natural vegetation is not restored before the first heavy rains start to fall. If the carrying capacity is not exceeded, vegetation may restore fast, but often this is not the case (burning combined with overgrazing).
If burning takes place yearly, an increase of the hardest and unpalatable grases is promoted. A burning frequency of once in every 2-4 years is supposed to be best to maintain a vegetation which is most profitable for grazing. (Werger & Colaris, 1975).

Grazing has important effects on the vegetation. Moderate grazing can alter the composition of the grassland; the more palatable grass species disappear. Overgrazing causes bush encroachment in drier areas (less than 600 mm rain/year, South-West Zambia), because the deep rooting woody plants get more water. In erosive areas, an effect can be the total disappearance of vegetation.
Timmermans (1982) states, that because of grazing, the productivity of a grassland can increase, depending on the time of grazing, which parts

of the plants are used, and how much grazing takes place. When the grazing pressure is low, the biomass above ground increases, this because of the forming of shoots and an increase of the diversity of the vegetation.

Overgrazing is often accompanied by trampling. The mechanical impact of trampling causes both direct and indirect damage to the vegetation cover. The direct damage is clearly visible but the indirect damage has a long-term effect on the soil fertility. The indirect damage leads to loss of soil fertility and slower recovery rates of the vegetation through the loss of soil structure and subsequent loss of aeration and permeability of the soil. The loss of aeration hinders plant root functioning and the loss of permeability often leads to water erosion through increase of overland flow (run-off). On dambos and slopes surrounding dambos, severe water erosion can occur.

3. The Social Aspects Inventory.

In this chapter, some of the main features of Zambia's economy and social system will be summarized. More detailed and extensive information is available in the Draft Report.

3.1. The economy of Zambia as a whole.

From the beginning of the seventies, Zambia's terms of trade have declined drastically. In 1982, Zambia had to export 4 times more goods than in 1970 for the same value of imported goods. This decline will probably continue. Zambia's gross domestic product (GDP) has varied between 1300 and 1400 million Kwacha, on a 1970 price level basis. If adjustment is made for the shift in terms of trade, a decline in the real terms of the GDP, from 1300 to 900 million K in 1982 becomes apparent (Economic Report, 1982). Since no structural improvement of the world Copper prices or other export opportunities are expected, it is clear that Zambia's development will have to be based upon austerity and upon increased and more diverse production for the African and home market, rather than world trade and Copper.

The most important set-back for Zambia's development is the ever increasing shortage of food. If this process is not stopped, an increased suffering of the population can not be averted. Zambia's government budget has been faced with growing deficiencies. By the end of 1981 the government debt had increased to 1700 million K. Although nominal expenditures still increased in these years (mainly for subsidies of maize and fertilizer, higher wages and an increase of defense budget), real expenditures, and especially real capital expenditures, were squeezed. Of the nominal capital expenditure of some 200 million K per year over the 1977 to 1981 period, most was spent on maintenance and only 20 % on directly productive investments. In 1982, at the instance of the IMF, the government took austerity measures and partly re-established the price mechanism.

3.2. The structure of the Zambian economy.

Zambia's economic structure is unbalanced in many respects, mainly as a result of colonial rule, that hardly paid attention to more than one region, one product and one class of people: the Line of Rail area, the copper mines and the elite. Everything else was neglected or viewed as a service function only, like the urban wage earners and the commercial farmers. Politically, this has changed. Economically, the old structure is still largely present.

During the seventies, the poorest 60% of the population earned only 20% of the national income. In view of the austerity measures, this picture will not have changed much by now. Paid labour is still only available to some extent in the Line of Rail region. This attracts young men from the rural areas, giving rise to labour shortages in the traditional land use systems.

The construction of new roads and railroads has somewhat alleviated the extreme "centre-periphery" character of Zambia. This opening up the rural areas may result in two different things:
- either an increased pulling power of the urban areas and establishment of new centre-oriented and centre-dependent, specializing functions along the new axes;
- or increased opportunities for integral regional development with some degree of self-reliance vis-à-vis the central region.

In our view, for three peripheric regions the second type of development will have to be stimulated, not only for the sake of the regions themselves, but also for the efficiency of the Zambian system as a whole.

3.3. Urban and rural life in Zambia.

The urban areas attract most of Zambia's high rate of population increase, estimated at 3.1% annually. Since almost 50% of the people live in the cities, they grow at an annual rate of approximately 6%. Employment in the formal sector remains approximately constant at a number of 400.000 jobs, including those at the large scale farms. The informal sector is approximately of equal size in terms of jobs. It comprizes many small-scale retail, manufacturing and building activities, as well as charcoal burning, repair jobs etc. Zambia imports many day to day necessities which could be fabricated by the informal sector. Fortunately, the government nowadays recognizes this innovative potential (Todd and Shaw, 1979), but at the moment the informal sector is unable to absorb the yearly number of 40.000 new job seekers, mostly young school leavers (Ohadike, 1981). This human resource is largely left untapped.

Vegetable gardening is an important activity of the urban low-income households, especially those who are established for a longer period. Larger plots are located on vacant land and often 'illegal'. In some Copperbelt towns, official leases are issued; the increased security results in increased output (Food Strategy, 1983).

Outside the Line of Rail area most of the people are involved in subsistance agriculture in largely traditional ways. Zambia's seventy tribes practise a wide variety of land use systems in a wide variety of social settings. Some examples may suffice to illustrate this diversity. The *Bemba* of the Northern Province are the agriculturalists of the "large circle Chitemene" system. Their originally matrilinear and matrilocal society is headed by chiefs, but the clans do not hold a specific territory. (Whiteley & Slaski, 1951). The *Ila* of the Southern province are primarily pastoralists, organised in chieftaincies that claim strict territories. The cattle, raised on the rich Kafue floodplain grasslands, are the cultural focus and economic mainstay of the relatively wealthy and independent Ila society (Fielder, 1973). The

Tonga of Southern province do not adhere to strict rules of kinship and settlement. Also, they do not have chiefs. The traditional land use system is a mix of shifting cultivation and cattle keeping. In many respects, the Tonga are a people in transition. Having been confronted with the large scale commercial farms along the Line of Rail as well as the more recent Kariba Lake, the Tonga are in many respects a people in transition, shifting towards establishment of stricter land rights and semi-commercial maize farming. (Colson, 1962). The *Lozi* of Western Province have ruled over this originially multi-ethnic area for a long time. As a result of this one-tribe dominance, there is a great inequality in wealth and Western Province people face the need of a double loyality: to the Lozi King (the Litunga) as well as to Lusaka. The Lozi are patrilocal. Because of this, families in Western Province tend to become more and more of the nuclear type, with a loosening of village ties (Prins, 1980).

It goes without saying that successful rural development planning will have to be aware of and incorporate this type of characteristics. People do not operate on the basis of the planner's perception of their life security, but on their own perception of it. Moreover, social characteristics shape much of the agricultural activities of local people. As an example: many chitemene circles are worked for too long a period without new land being cleared; this clearing is the man's job and the men are in town. And: the shift from millet to maize in Western Province can be attributed to the nuclearization of society; millet is more vulnerable to bird damage and bird scaring can only be organized at the village level.

4. THE LEGEND OF THE NCS-MAP.

In the course of our NCS design process, we have made and integrated regional plans for six regions (covering Zambia completely) and fourteen sectors, like forestry, mining and nature management, as explained in Chapter 1. In this summarizing report, these intermediary results are left out. If desired, the Draft Report may be referred to.

In this chapter, the legend of the NCS map will be explained, going through the legend units in an arbitrary sequence. In the next chapter we will focus on some "unmappable" elements of the NCS.

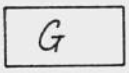
Food is the key for Zambia's future and basis for the natural resources and land use systems are the key for a sustainable food production. Throughout the country, the nutrient content of the soil is the limiting factor for crops. Only in the Luangwa and Gwembe Valleys and in the extreme south, water is (co)limiting (Schultz, 1976). As for cattle productivity, both the soil fertility and the occurence of tse tse are limiting, exept north of the 1000 mm isohyet, where the rainfall favours trees in their competition with grasses (Verboom, 1982).

The feasibility of options to overcome limiting factors depends on a variety of factors:

- *the ecological basis* (when will other limiting factors take over? how much input is required for a sustainable increase in output?)
- *the available know-how and labour and other social features*, like those mentioned in the previous chapter
- *the accessibility of markets*, as a function of infrastructure, population densities and transport costs
- *specific demands* (like the fuelwood demand near towns), *specific risks of side-effects* (like erosion risk on escarpments) and *specific interferences* with other or non-agricultural land use (like interference with cattle, wildlife cropping or tourism).

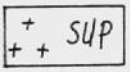
On the NCS-map, we recommend the following options for a sustainable increase of agricultural production. The legend units concern specific crops as well as projects and overall regional programmes.

In our NCS map, we recommend the following means to increase agricultural production to be applied or studied.



GROUNDNUTS

Intercropping in time and space of the N-fixing groundnut or another leguminous crop.

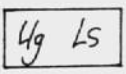


SWAMP USE PROGRAMME: improvement of the nutrient supply of the surrounding soils, by using swampmaterial.

DREDGING OF CHANNELS

In principle, material dredged out of swamps (mud, humus, plants) may be used to improve soil fertility. Such a use is only relevant for an NCS if it is sustainable. The natural resource has to be able to restore itself. This situation is only possible if the amount of dredged material equals the amount of material which will regrow by natural succession processes. Initial dredging which will not fullfill this condition is needed for the infrastructure within the swamp. A lack of oxygen and a resulting low productivity is characteristic for Zambia's Bangweulu and Lukanga Swamps (Huckabay, in: Johnson & Roder, 1979). Dredging activities may enhance the productivity of fish, which is another justification of this recommendation.

The acidity level of the dredged material is probably too high for direct application on the acid soil (mean pH 4.8), which surround the swamps in most places. Mixing with lime or calcium will then be needed before distribution.
It must be stressed that this recommendation should not be put into practice before research on the environmental effects of the dredging activities on the swamp's ecosystem, the nutrient amount of the material before and after transport (contact of humus with O_2 will cause mineralisation) and possible improvements of this situation, the cost|benefit analysis etc. have shown the recommendations relevance.



UPLAND GRAZING
LIVESTOCK (Improvement or Introduction)

The introduction of cattle in the traditional Zambian land use systems in the past, served to the decrease of the limiting factors soil fertility (manure) and labour (A.D.P.; Animal Draught Power). For the traditional farmer cattle formed an opportunity to commercialize. However, this often led to the ignorance of other cattle production possibilities (milk, meat) and of the factors on which the density and distribution of the cattle depends.

In this NCS, attention to cattle breeding is paid in the following ways:

We recommend that optimal use should be made of the grass production capacity of the floodplains, because
- their grass quality is high
- the crop choise is limited by the flood regime
- the advantages of mixed farming
- the productivity of cattle (A.D.P., milk, manure).

Especially in the higher rainfall areas, upland grazing problems may arise, because of the differing carrying capacities (beasts/ha) of the floodplain itself and the areas surrounding it, on which the cattle graze when the plain is flooded. The following measures might prevent upland grazing problems:
- supplementing grazing in the uplands by the provision of hay, silage, fodder and browse trees.
- selling the cattle before the period of flooding
- creating upland meadows, making use of artificial fertilizer, improvement of the grass species etc.

It will be clear that only commercialized farming systems are feasible for the last two measures. The overall legend is: Ug.

The introduction of cattle is only feasible:
- if commercialisation of cattle breeding is aimed at. In these cases only certain functions of the cattle are used: e.g. producing milk for the urban population,
- in the case of work-oxen programmes. A local organisation should be occupied with the care, hire, etc. of oxen-spans.

The improvement of livestock type and livestock management is feasible in many places in Zambia. Care should be taken to keep intact the most important function of cattle in subsistence systems: a food resource for unfavourable years. Hence, new livestock or management types that have an increased vulnerability to drought and other hazards will not be succesful, irrespective of their possibly higher production efficiency (conversion factor) The overall legend is: Ls.

R + WB

INTRODUCTION OF RICE AND WATERBUFFALOES (BES BUBALUS BUBALUS)

Rice, being a wetland plant, could be grownin low-lying parts of floodplains. Nowadays, the acreage of cultivation of rice is small in relation to the acreage of cultivation of maize and cassava in these places, while these crops yield low because of the high watertable and a high cropfailure risk due to a varying beginning of flooding time.
Cultivation of rice is limited by its labour intensive character. In Asia a part of the human labour is replaced by using the draught power of the Waterbuffalo.
An NCS recommendation is enlargement of the acreage under rice. Therefore, the introduction of waterbuffalos is a precondition. Besides power, waterbuffalos produce milk, meat (comparable to that from cattle of the same age group) and manure. Another advantage is that they can graze while the floodplain is partly under water. Formerly, semi-aquatic animals grazed on these places at that time of the year, but nowadays,due to hunting pressure, a niche is left open; the grass has to be burnt when the floods subside, because it has died and it hinders new grass shoots. The waterbuffalo could partly occupy this niche. (Verboom, 1982). In the case of upland grazing problems the upland pressure can be reduced.

Ff.

FERTILIZER FACTORY

LAI

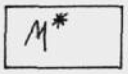
LOCAL AGRICULTURAL INDUSTRIES

LAI's can serve as a combination of agricultural and industrial development in the region. Both market(opportunities to sale) and infrastructural problems will be decreased, which will have a positive effect on the cost/benefit ratio.
The industry should rely on farmproduction for local raw materials, for food for its workers and for foreign exchange.
The agricultural sector should rely on the demand by the urban population (more than it is now) and the industrial sector while on the other hand it should form the home market for manufactured goods.
Some examples of linkages between industry and agriculture are food processing activities, the production of packing materials for the processed products and the production of implements for usage in the agricultural sector.

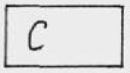
Concerning agricultural land use, we made choices between the different land use options per location, through combining and comparing the expected increases in production. In the first place, a choice had to be made between intensive or extensive types of land use. With an intensification of land use, commercialisation of agriculture is inherent. Extensification of land use can be divided in

- basically traditional agriculture (with population densities below the critical population density)
- agroforestry (with intensification on small scale)
- biosphere reserves.

COMMERCIALISATION OF AGRICULTURE



HIGH YIELDING VARIETIES, MAIZE AND OTHER CASH CROPS

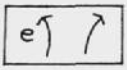


CROPS: G Groundnuts, Sb Soybeans, Ct Cotton, S Sunflower
V Vegetables, P Pineapples, Co Coffee, Te Tea, M Maize

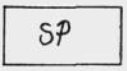
Commercial farming is recommended:
(1) Where *climate and soil conditions* are most favourable for agriculture. This is the case between the 800 and 1000 mm isohyet. North of the 1000 mm isohyet soils are heavily leached. Furthermore, the use of artificial fertilizer is inefficient and extra expensive as approximately two third of the amount used, will be lost due to the leaching effect of the rainfall, influenced by soil conditions. South of the 800 mm isohyet there is a considerable drought risk for cropping.
Highest potentialsoils are shown on Map 1. (soil potentials)
(2) Where *market and infrastructural conditions* are most favourable. Expansion of commercialised agriculture is recommended along important routes; LAI's, tarring and improving roads should stimulate commercial farming.

Besides cash crops such as soyabeans, sunflower and tobacco, the commercial farmer in the line of rail area should grow high yielding varieties of maize. The commercial farmer outside the line of rail should grow groundnuts instead of a surplus of maize. This is because groundnuts have a higher value to weight than maize. Furthermore, the groundnut is a highly recommendable crop for emerging farmers, because the cultivation of the crop requires none or very little cash input in contrast to hybrid maize, while it can give an income equal to maize (provided there is seed and sufficient family labour (groundnuts are labourintensive)).(Schultz, 1976).

It is recommended that the land use in the remaining parts of Zambia will be extensive.
Basically traditional land use, with a number of persons per square km. not exceeding the carrying capacity of that land use system, should be maintained.
The cultivation of the traditional crops such as groundnuts, beans, sorghum, bulrush and finger millet, should be encouraged here, instead of maize and cassava. The most important way to achieve this situation , is the abandonment of the discriminating price and subsidy system.



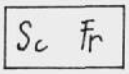
EXTENSIFICATION OF AGRICULTURE AREAS/ZONATION
EXTENSIVE - INTENSIVE



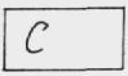
SETTLEMENT PROGRAMMES

Extensification of land use is recommended where the maximum number of persons per square km is exceeded and intensification is not feasible. This is the case in the rural areas of the Northern, Luapula, and North-western Provinces. F.i. in the large circle chitemene system in the Northern Province, the maximum populationdensity is 1,6 persons/sq.km. In 1969 the population-density was 3.7 persons/sq.km. Extensification should be linked with Settlement Programmes. These S.P.'s are placed within IRDZ's, areas of accelerated regional development (see below). By offering opportunities to earn a living, people are to migrate to these IRDZ's voluntarily. It is, concerning the SP's, important that
- a survey will be made of the social, political and economic situation of the area and of the people concerned
- consultation with the people should take place because much adaption on the part of the people is necessary.

AGROFORESTRY



SPECIAL CROPS/FRUITS; Sc: mangos, pawpaws and bananas.



CROPS; Co Coffee, Te Tea, Ct Cotton

Agroforestry is a collective name for land use systems in which woody perennials are deliberately grown on the same piece of land as agricultural crops and/or animals, either in some form of spatial arrangement or in sequence. In agroforestry systems, the woody component interacts ecologically and economically with the crop and/or animal components. Such interactions will take many different forms, both positive and negative, and they need not remain stable over time. (ICRAF).
A great number of variations is thinkable. F.i. fruittrees planted on a slope in a competent way, can decrease/prevent erosion, produce fruit and at the same time make it possible to cultivate coffee, tea, plants which need shade in their first stage of growth (provided the ecological conditions favour their growth also). Agroforestry is recommended on the escarpments surrounding the plateaux.
Traditional agriculture is not recommendable on these sites, because of the high risk for erosion, resulting in a low carrying capacity. Special crops/fruits should be cultivated wherever the climatic conditions favour it. This is the case in the Gwembwe and Luangwa Valley, where the tropical hot and dry conditions favour, under irrigation, a wide range of tropical crops. However, whether these crops could be grown economically remains the question. Among those with good prospects are most likely bananas. In addition, rice and vegetables are potential crops under irrigation. Cotton (cash crop) is probably a suitable crop of dry land farming (Schultz, 1976).

The tropical hot and wet conditions at the escarpments of the Northern Province, between Lake Mweru and Lake Tanganyika, allows the growth of oilpalms, mangoes, pawpaws and bananas. The oilpalms produce low-quality fruit and supplementary irrigation would be required to improve the standard.
It must be doubted, however, whether this could lead to production on commercial scales. Mangoes, pawpaws and bananas seem to do well. Other crops with high potential might be paddy rice and perhaps cashew nuts. (Schultz, 1976).
In the northern part of the Northwestern Province and in the southeastern part of the Northern Province, the growing season is the longest of the country (1200 mm rain/year and 6 humid months/year). This is long enough to allow the cultivation of perennials like pineapple, coffee and tea.

Besides favourable ecological conditions, a good infrastructure is a precondition for stimulating the cultivation of special crops as cash crops. F.i. the cultivation of pawpaws, mangoes and bananas in the area between Lake Mweru and Lake Tanganyika should only be encouraged if a biosphere reserve with an infrastructure (e.g. an air-field) for the tourists, will be established in the northernmost part of the Northern Province. An infrastructure should not

be improved only for the sake of the special (cash) crops (too much costs in relation to benefit), except for some exotic products-directed LAI's.
Areas with a bad infrastructure should primarily produce for needs for local food and fuelwood.

INTEGRATED RURAL DEVELOPMENT ZONES

The IRDZ's form an important component of the NCS. An IRDZ should give an impulse to establish, as much as is possible, an area with independent economic growth dynamics, based upon product diversity, population density, overall integration, productivity and stability. Within an IRDZ both intensive (with improvement of the infrastructure and the establishment of LAI's) and extensive land use are recommended. IRDZ's are recommended in areas where we see potentials which remain underexploited at this moment, due to a lack of money, organisation, know-how, etc.
IRDZ's should attract people to immigrate, esp. from areas with a too high population pressure on the traditional land use systems.
SP's are placed within IRDZ's.

The proposed IRDZ's are:

IRDZ 1: The triangle enclosing the Chambeshi Flats.

The area is situated on the northern plateau, partly on the edge. The Chambeshi Flats form the central part of the IRDZ. The traditional shifting cultivation (large and small circle chitemene) on the north west side of the flats, can not produce enough food for its inhabitans; overexploitation (too short follow periods, too long continiously cultivation, more deforestation than is supplied by regeneration of the wood, shifting cultivation practices on too steep slopes) has led to degradation of the soil, deforestation and erosion.
On the southeast side of the Chambeshi Flats, the carrying capacity of the traditional shifting cultivation is enlarged through the use of cattle manure. Cattle graze on the flats when the waterlevel is low. During the flood the cattle recede to return to the uplands. Pastures used during this floodtime grazing, are inferior to those on the plains when the floods subside. The introduction of an animal factor in the northern areas, did not occur because this area lies north of the 1000 mm isohyet and consequently treegrowth is abundant instead of grassgrowth. So the difference in the uplands is too great. F.i. 10-20 acres/beast on the Zambezi floodplains and 40 in the Kalahari sands (Verboom, 1982).
The main reasons for recommending on IRDZ here, are the underexploited production potential of the floodplain grasslands and the too high population density in the traditional agricultural areas.
Other considerations have been the existence of rather good infrastructural services, the availability of labour and market facilities, a potential for exportpossibilities to Tanzania and the relatively small 'pull effect' of the Line of Rail area at this distance.

In 'Upland grazing/Livestock (improvement/introduction)', the recommendations that could be applied to make more use of the production potential of the floodplain, are described. The recommendation for Rice and Waterbuffaloes is also feasible here.

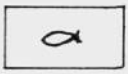
IRDZ 2: Bangweulu Swamp and its western border zone.
The IRDZ is primarily based on the possibly feasible Swamp Utilisation Programme (SUP), explained under the SUP legend unit. If no sustainable use can be made of the swamp, the whole IRDZ must be dropped or redesigned.

The main reason for recommending an IRDZ here, besides the presence of the relatively unproductive Bangweulu Swamp, is the too high population pressure on the large circle chitemene system, practised in the uplands. Lime for neutralisation of the acid swamp product is available from the mines southwards (Mansa District or Copperbelt). In these high rainfall areas, artificial fertilizer which is applicated will be lost for approximately two third; organic material out of the swamp can retain nutrients for a great part, so in combination with the SUP the use of artificial fertilizer may become much more feasible. Rice and waterbuffaloes are recommended in the South Bangweulu Floodplain.

IRDZ 3: The rural areas near the Copperbelt.
The main reasons for recommending an IRDZ here, are the high population pressure in the block chitemene system (in 1969 2.0 persons/sq. km, Schultz 1976) and its situation near the urban areas/Copperbelt. Commercial farming (high yielding varieties) is an important part of the IRDZ; livestock introduction is only feasible on commercial basis. The cultivation of vegetables by local people, is a recommendation that takes up the attempts of the Lamba to commercialise. These attempts were not that successfull, because of a decreasing demand, lack of material, migration to town and a social atomism (the Lamba live apart) that keeps individuals from cooperating. (Siegel, 1979). By tackling these realities, in an IRDZ a new impulse could be given to grow vegetables for the urban market. (Because of its more specialized and cities-dependent character, the proposed programme might as well be named a Special Rural Development Programme).

IRDZ 4: The Barotse Floodplains.
The main reasons for recommending an IRDZ here, are the isolated position of the area, the great sense of identity of the Lozi, the large floodplain grasslands and the too high population pressure in relation to the traditional land use system.
Over-exploitation of natural resources has led to deterioration of the upland-pastures, neglect of the cattle, loss of humic soils and consequently erosion. Measures to prevent this loss are described in legend unit ⌐¬. Intensification of agriculture around Mongu, upland-grazing/livestock (improvement/introduction), the introduction of rice and waterbuffaloes and afforestation on the eastside of the Zambezi River should be combined in order to make this region more productive in a sustainable way, without impairing its relatively self-reliant character.

The development of the rural areas in the ways decribed above is only possible with the help of the government, providing in subsidies, credit facilities, good prices, also for traditional crops, extension etc. A development on their own power cannot be realized. This implies a shift from a more intensive industrial orientated economic policy towards an agricultural oriented policy.



STIMULATION OF FISHERIES

Fish is an important protein source for the rural as well as for the urban population, especially the low income groups. The fisheries of Lake Mweru, Lake Tanganyika and Lake Kariba should be stimulated in their productivity because these are relative stable lakes and the effects of illegal fishing will be less here (mainly open lake). Fishing in floodplains should not be stimulated because floodplains are too variable in waterlevel and fishload. Stimulating of the fisheries mainly consist of the improvement of the marketing situation, i.e. road improvement, establishment of boats, nets and engine plants and the providing of more storage and freezing facilities. The research into the improvement and the implementation of the fishing methods (in balance with the conservation measures) that will offer the small-scale fishermen opportunities (e.g. the ability to go offshore) for a little capital outlay, should be stimulated.
But such a development can not do without intensive research and management, as it will surely encourage illegal and overfishing, resulting in unstable water ecosystems, decline of fishspecies, shortening of the foodchain and consequently a decreasing total production.

MINING; Cl = Coal, Fe = Iron, Cu = Copper, Li = Lime

The main feature of mining is its intrinsic insustainability. Therefore, funds earned by mining should be regarded as a temporal benifit which has to be invested in sustainable production activities or their infrastructural basis, like rural development, roads, education etc. Direct use for food imports or other consumer goods only hampers development.

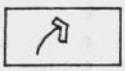
Copper mining is and will stay important because of its capacity to earn foreign exchange. That's why, although the demand for copper in the world market is decreasing, resulting in falling copper prices, the present production level of the existing copper mines should be continued. However, exploitation of new copper reserves should not be undertaken in the near future. Only when copper prices are rising significantly or the reserves in the Copperbelt are depleted, copper production at Lumwana and Kalengwa may be considered, if these ore reserves are proven to be economically exploitable at all. Then, coppermining will stimulate other economic activities in the Northwestern Province.

On the basis of our guiding principles some preconditions for mining activities have to be made. Mining must not take place in environmentally vulnerable and precious areas, especially National Parks, because of environmental problems caused by mining, like water pollution, waste dumps and the effects of transport of ore. If mining is started, environmental problems should be prevented by limiting environmental impact as much as possible. This can be done by means of an obligation for mining companies to pay for an independent Environmental Impact Statement, to evaluate various options to limit environmental impact. Other recommendations are the enactment of the 'The Polluter Pays' principle and the enactment of legislative and administrative measures to restrict pollution, like permissions for the storage of waste material.

Iron mining may become an important activity in the future because of the possibilities for import substitution and stimulation of regional economic activities. For the time being, however, iron-ore exploitation should not be undertaken because of the low world market prices which makes import economically more beneficial than own exploitation. Environmental considerations play a role in this recommendation too.

Coal mining can be extended. Coal can be used to reduce the dependence on expensive imported oil, so it fits in with the principle of self-reliance. Careful exploitation is necessary because of effluent to Lake Kariba, which might affect the fish resources.

Mining for lime is already an activity in the Line of Rail area (Ndola, Lusaka). Extension of mining could help to push agricultural development in Northern Provinces. Acid soils in Northern Province need agricultural lime for correction of acidity, e.g. to improve agricultural production in the Integrated Rural Development Zones. The location on the map is not exact, but according to Lang & Mansfield (1975), lime resources are available in Northern Province. In fact, a location close to the market area has to be found, in order to reduce transport costs. In the quarries themselves, measures to control erosion are necessary.



IMPROVEMENT OF ROADS

The upgrading of existing roads and construction of new roads are often preconditions for economic development all over Zambia. An unrestrained transportation of products to market areas and supply of inputs, fertilizer, tools, machinery, fuel, seeds etc., must be guaranteed. In Zambia special attention must be paid to the quality of roads during and immediately after the wet season.

In the present situation, roads often suffer from water erosion, bridges are washed away by swollen rivers and heavy traffic causes immense potholes. Many of the maintenance activities like filling potholes, digging and maintaining adequate drainage to stop erosion can be organised at local level with use of simple tools.
Concerning the construction of new roads, a shift towards an increased labour-intensity has to be considered. Especially in not too sparsely populated areas. As an example in many places a mix like quarry excavation by hand /loading by hand / transport by lorry / grading by hand / finishing with a roller has proven to be more optimal than capital intensive construction.

Southern province.

Roads connecting the agricultural production areas and the urban markets, directly (Muchinga escarpment and Choma) or indirectly with rail connections, should be improved. Examples are the Lake Kariba and Muchinga escarpment areas, that produce a variety of products such as tropical fruits and fish. Those products can be transported to Choma by lorries and from Choma to other towns in the Line of Rail area, by train. The same applies to the coal production in the Muchinga escarpment area, where an extension of coal productions could make a rail connection feasible in the future.
Another example is the area to the west of Choma; a better accessibility will benefit the commercialisation of agriculture, offering chances to sell the production surplus on markets along the Line of Rail.

Western Province.

The connection of the Zambesi floodplain and Sesheke must be improved, for the transportation of the meat surplus of the Integrated Rural Development Zone and for the products of the plantations (sunflower) along the road. The condition of the road must be sufficient during the beginning of the wet season, because the surplus of cattle must be transported before the river inundates the floodplain. On the floodplain, transportation can take place by boat along channels.

Northwestern Provinces.

The connection Solwezi-Kasempa must be improved because of the transportation of products like vegetables, soya-beans, cotton and pineapple to the copperbelt.

Northern Province.

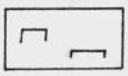
The road Serenje - Samfia - Mansa, also mentioned in the Third National Development Plan, becomes the main link between the IRDZ and the national market.
Artificial fertilizer can be transported from elsewhere to support the Swamp Utilisation Project. Inside the IRDZ the road benefits the distribution of agricultural inputs like mud, lime and

fertilizer and the transportation of the surplus production to other areas. The road is also significant for the safe transportation of fish from the fisheries in the North to the Line of Rail markets. The existing road from Mansa to the Copperbelt is not sufficient because it runs through Zaire.

Eastern Province.

Several roads should connect the Luangwa Biosphere Reserve (explained further on) with towns in Eastern Province. Some also serve as connections in the Reserve itself. The roads serve the purpose of transportation of agroforestry and game ranching products to markets and food processing industries (Local Agricultural Industries). Other purposes are the supply of food from Eastern Province to the Reserve and the transportation of inputs for activities in the Reserve, from the Local Agricultural Industries of among others, Chipata and Lundazi. Safari tourists will be transported to the Safari hotels and camps in the Reserve and to the Game viewing and safari hunting areas in and near the National Parks.

A condition for the location and construction of roads in the Biosphere Reserve is that the effects of the roads on the protection of wild life must be taken into account. A special warning must be made due to the fact that better roads can be in the advantage of poachers.
That is why there are no roads planned right through the Reserve in the direction of the Line of Rail and special protection is planned where roads will run in the neighbourhood of National Parks (ref. the 'special protection' legend unit of National Parks).



MAINTENANCE OF DRAINAGE SYSTEM

The traditional exploitation system of the peat soils along the edge of the Zambesi floodplain and subsidary rivers of the Zambesi river, is endangered. Originally, wet peat soils were drained with culverts. Drainage lowers the water table and makes agriculture possible. Nowadays these culverts are neglected and often do not function sufficiently anymore, due to two district developments:
a. Culverts are overgrown with weeds, the original swamp ecosystem is reestablished and agriculture impossible. Verboom (1982) recommends to convert land use into pastures for cattle.

b. Overdrainage may occur if culverts become too deep through erosion and develop into gullies. The consequences of overdrainage are that the water table is lowered too much and the mineralisation of peat is increased and eventually the peat soils are destroyed. The underlying infertile sandy subsoil can be uncovered and agricultural productivety will drop. Already before this will happen, agricultural productivety will drop because of severe desiccation of the peat soil.
Apart from the loss of agricultural production potential, upland grazing problems will occur. Cattle that graze on the floodplain during the dry season cannot find enough upland pasture when the water begins to rise at the end of the wet season.

Overdrainage is an environmental problem with far-reaching consequences for the people of the Zambezi floodplain. The solution is to return to a drainage situation with the water table just above 0,50 m below the surface to stop desiccation and increased mineralisation. Research is necessary to find out why the traditional drainage system does not work anymore. Then a detailed strategy can be designed to build sluices and refill gullies, with as much help as possible from the local people.

AFFORESTATION AND FOREST PROTECTION

Wood is one of the most important natural resources of Zambia. It serves as timber, which is of local and national importance and it is exported. It serves as fuelwood in rural areas and smaller towns, as charcoal in lager towns. Woodash serves as fertilizer in the Chitemene shifting cultivation system. At present, in many places in Zambia the rate of deforestation through increasing exploitation of this resource, surpasses the natural rate of regeneration. Because there are no viable alternatives to replace the use of wood (fossil fuel is imported but too expensive for most purposes), increasing scarcity will occur. Consequently, the traditional agricultural system will progressively collapse in the near future and the urban population will suffer from the lack of fuelwood and charcoal.
Apart from the use of wood, trees, woodlands and forest constitute an essential component in the ecosystem; water management, soil functions etc. are inproved and protected by forest. The widespread destruction of trees, woodlands and forests will result in ecological degeneration, like increased erosion and flooding that will influence the existence of the people in a very negative way.

Therefore action should be taken on the following points:
- protection of woodlands and forests which serve purposes like the protection of excarpments from erosion and the preservation of the water management, especially in the headwaters of rivers,
- protection of unique ecosystems (ref. National Parks and Biosphere Reserves),
- afforestation programmes wherever forest products are needed and can't be sufficiently rendered by exploitation of the natural forest or woodland.
  Preferably the afforestation should take place in the vicinity of the market areas, especially in areas where the transport system is not well developed or physical factors like rivers and mountains limit the possibilities for transportation.

A condition for afforestation programmes is that conflicts with the interests of the local people have to be avoided by involving them as much as possible in the entire process of afforestation planning and execution. Afforestation programmes are often only successfull with the cooperation and support of the local people and this can only be realised if the programmes are in their own interest, e.g., if the chosen tree species are adapted to local demand.
The government can assist in planning the afforestation and provide tools, seeds, seedlings, etc. Perhaps local organisations and institutions like schools, Farmers' and Women's Associations and mission posts can help with the instruction of the local people and distribution of seedlings etc. in cooperation with the Forest Department. Tree nurseries should be started in the villages whereby afforestation programmes are planned.

More specifically, the afforestation recomendations are as follows:

Northwestern Province.

Afforestation of species suitable for the timber market; extension of existing forestry.

Western Province.

Afforestation around the Zambesi floodplain for local application as timber and fuelwood, is recommended. The shortage of fuelwood is acute; people even dig for tree roots to serve as fuel. Afforestation browse trees for cattle may help to diminish upland grazing problems. Special production forest produce timber for the national and international market. Especially Zambian teak is an important source of foreign exchange. The exploitation of commercial species surpasses the rate of regeneration. Afforestation of these species is needed to satisfy the demand in the future. The locations of special production forests on the NCS-map are chosen according to soil and climatic conditions.

Central and Southern Province.

The tree species used in afforestation programmes should be adapted to the mainly urban demand for charcoal and timber. In the neighbourhood of local centres of development, marked as LAI on the NCS-map, afforestation should provide fuelwood and timber for small-scale agricultural industries.

At present, around many towns in the Line of Rail area, a zone of about 50 km is already completely deforestated. Chidumayo (in Johnson & Roder, ed. 1979), estimated that the present rate of deforestation means that there will not be any exploitable woodlands or forest left, within a period of only 25 years. Although Chidumayo did not include natural regeneration into his calculations, it is clear that an increase of the afforestation efforts will be needed to restore the balance of growth and utilisation.
For every region the wood demand can be calculated and then the afforestation necessary to meet this demand can be planned.

Preferably the afforestation should take place close to the market for wood. In the neighbourhood of towns careful planning is needed to satisfy the demand for both food production and wood production. Small-scale woodplots can probably best be fitted in the existing spatial structures of land use systems, e.g. on plots where the soil is not suitable for agriculture. Trees can be planted along roads and around gardens. Trees can also be used in rehabilitation programmes for waste dumps, quarries and eroded areas. Fast-growing species, e.g. eucalyptus and acacias, seem ideal for providing fuelwood and charcoal. However, the existing monocultures of fast-growing species have some disadvantages. Especially if a second generation is planted, soil and groundwater resources may become depleted and the second generation will fail. Generally, monocultures are also more susceptable to plagues.
The conclusion must be that it is important to bring diversity of tree species in plantations and plantation of local species can be rewarding in the long run, because they are most adjusted to the local environment.

Northern and Luapula Provinces.

The Map shows afforestations around LAI towns and a large-scale production forest in the South. The motivation for afforestation in Northern Province is the shifting cultivation land use system which places high pressure on the natural forest and woodlands. The afforestation around towns is meant to attain self-sufficiency in wood production, to relieve the pressure on the natural forests and woodlands.
The Southern part of the Northern Province is very suitable for large-scale afforestations because it is sparsely populated and relatively close to the densely populated Copperbelt area, where the demand for wood is high. However, transportation through Zaire will have to be improved.

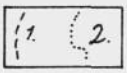
Eastern Province.

The aim of the afforestation programmes in this Province is to fulfill the local demand for fuelwood and timber. Some Local Agricultural Industries in this region need lots of wood, e.g. the tobacco industry.


NATIONAL PARKS


PROTECTION NATIONAL PARK


BIOSPHERE RESERVES



PROTECTION ZONES

GAME RANCHING, GAME VIEWING

The existing National Parks need more protection, either by maintaining the present frontiers while improving management or by placing them within a larger entity: the Biosphere Reserve.

National Parks and Game Management Areas (GMA) are the singlemost important areas for the survival of wildlife in Zambia. No indigenous animal species is extinct yet, thanks to the early institution of National Parks and GMA's and legal protection of these parks. The importance of protection of wildlife is explained in detail furtheron. The legal protection and the generally low potential of the parks for agriculture, due to generally poor soils, tse tse infestation and deficient infrastructure, helps to maintain the refuge function for wildlife. However, the wildlife of the National Parks and Game Management Areas is severely threatened by poaching, tse tse control, mining, unbalanced populations of certain species, burning of the vegetation etc.

The legend unit 'Protection National Parks' on the NCS-map shows where either care should be taken to protect natural barriers against being broken through, or where activities of wildlife guards are to be intensified to safeguard the park from the activities of poachers. Experience in some parks has already shown that groups of well-trained and well-armed wildlife guards can limit the poaching activities significantly. The wildlife guards may also improve fire prevention and control and they can act as guides for tourists. It is recommended to recruit the guards from among the local people in order to involve them as much as possible in the protection of the park.

Protection of wildlife must be made rewarding for the local people as much as possible in various ways.

In our opinion, this can be realized in Biosphere Reserves. These reserves should aim at the improvement and integration of both wildlife protection and the possibilities for the local people to make a living. The initial costs and costs of management of Biosphere Reserves will not be high and will presumably be compensated amply by the income gained from tourism.

The reasons for establishing a Biosphere Reserve may be summarized as follows.
(1) At this moment, wildlife is relatively safe only in the National Parks. The animal populations are sometimes too small to be viable in the long run. If the protection area is extended or parks are linked, genetic exchange between populations will take place, preventing in-breeding.
(2) Many National Parks are vulnerable, especially the smaller ones. For instance, in dry years a shortage of water may arise if no permanent water is present within the area limits. If the area is extended, it can become more diverse.
(3) Often, animals have migration routes that go outside the park limits. Extension of the park will diminisch migration risks.
(4) The Park limits are abrupt. Along the Parks border, dense settlements and intensive land use systems may develop, that may severely affect the Park. The establishment of buffer zones, in which land use is restricted, serves to prevent this problem.
(5) People and their activities are an important factor in the establisment of environmental patterns. Seen on a large scale, many of man's activities are benificial for the diversity of the environment. Biosphere Reserves may incorporate and protect these values, if large enough to retain also a completely natural "core".
(6) The last, but certainly not the least reason for the establishment of a Biosphere Reserve concerns the status and perspectives of the people now living in the vicinity of National Parks. They are, in fact, already restricted in the land use of the full area surrounding them. If they are imcorporated in a Biosphere Reserve buffer zone, these restrictions will become official. At the other hand, they may now also reap the benifits of participating officially in the Reserve managements, from which they may draw income, an improved life security and a voice in the Reserve management.

A Biosphere Reserve will consist of at least three, and sometimes four, types of land use units:
(1) Central Areas, comparable with National Parks, with complete exclusion of human influences (no cropping, hunting, fishing, mining, tse tse control etc). Only some game-oriented tourism may be permitted in selected focal spots. Central areas must be large and diverse enough to be a secure"home base" for wildlife. Moreover they must serve to protect not only wildlife but the complete natural ecosystem with all its species and processes.
(2) Wildlife Transition Areas
In these areas, some small scale cropping may be permitted, as well as some fishing and hunting, strictly licenced, by the local people only.

Infrastructure must be non-throughgoing, geared to the needs of the local people only. Their production basis and life security are to be large and diverse enough so as to prevent intensive exchanges with outside markets. The main purpose of these areas is to prevent losses during transition from one (central or management) area to another, either, by depletion of the rangeland resource, poaching or obstacles. Design and regulations should be directed at achieving this with as little as possible management and interference with inhabitants.
(3) Wildlife Management Areas, with management aimed at a sustainable yield of wildlife products, primary land use may be game ranching, game cropping, safari hunting and the like. If not interfering with the wildlife objectives, other (regulated) land use systems may be allowed.
(4) Peripheric Areas, which may surround the other area types if necessary. Design and management should be multi-purpose, with wildlife as only one of the objectives, besides other aims to protect sustainability of land use and protect the Reserve as a whole. Escarpment areas may be among the peripheric areas, management being directed at preventing infrastructural "breakthrough" towards the central areas, prevent soil erosion, stimulate agroforestry etc. In peripheric areas, cattle should be allowed on a regulated basis in a way that does not threaten wildlife and the sustainability of the Reserve as a whole.

The borders of a Biosphere Reserve will be, if possible, natural borders (rivers, escarpment zones). This can be different in each reserve, because in each reserve there are other physical characteristics.
The motivation for this is, that physical borders are generally stable, they will nog be altered very quickly and are also ecological borders.
The size of the Biosphere Reserve will be dependant of:
- The size of the existing National Parks.
- The physical characteristics of the surrounding area.
- The maximum manageable size.
- The possibilities to combine National Parks.

Local people must be given the opportunity to effectively participate in the Reserve planning and management, sharing this responsibility with scientists and government officials. This involvement should include and safeguard financial and social benifits, through hunting, paid jobs, education and the like. This will enhance a situation in which it is the direct interest of the local communities to protect the Reserve against poaching and unsustainable use. The individual will have to be kept in check not only by regulations but also by his own community, by a sense of positive participation and responsibility in the Reserve management. Such a situation will not only be ethically desirable, but also more effective for Reserve protection.

In the NCS-map, three Biosphere Reserves are proposed: the Kafue, Luangwa and Mweru-Tangayika.

The *Kafue Biosphere Reserve* includes Kafue NP, Lochinvar NP, Blue Lagoon NP and the areas in between, including 5 existing GMA's. Blue Lagoon NP and Lochinvar NP are connected by a transition area, motivated by the need to give enough freedom to move to the Lechwe population. The present use by cattle herds of the area may have to be curtailed and regulated as far as necessary, but will probally not be necessarily excluded. The same holds for the present right of passage through the Lochinvar NP. Probably, herds will have to be accompanied by Reserve guards to ensure an undamaging passage.

The other areas are proposed to become wildlife management areas with safari hunting near the tourist centres and game cropping (regulated, but executed by local people) in the Flats. If cropping is done selectively, focussed on weak animals and older males, probably some 10% of the Lechwe herds can be taken off yearly. The Lochinvar abattoir has enough capacity to process the meat for the market.

In the wildlife management area of the Flats, probably most of the cattle present at the moment will be allowed to continue using the Flats. Since Lechwe prefer wetter circumstances than cattle, they are quite compatible. The total off-take of the Flat will increase by their combination. Direct competition may occur when the flooded area of the flats is extremely large or extremely small. In this respect, it will be of great importance to ensure a large enough freshet from the Itesitesi Dam in dry years. As stated by De Groot and Marchand (1982) at least 600 m^3/sec will be necessary.

The *Luangwa Biosphere Reserve* will establish an ecological and managerial integration of the present NP's and GMA's. The NP's will become central areas; existing provisions will be maintained. The left bank of the river will become one extended area with hardly any physical management, composed of the central areas and three transition areas. The proposed wildlife management areas have a high potential for game ranching (Motshwari, 1981). Several ranches may be established. The escarpment will become peripheric areas, protected against erosion, e.g., by an introduction of agroforestry systems. Care should be taken to guard the escarpment road of becoming an inroad for poachers and settlers from the nearby rail area, which is planned to increase in population density and degree of commercialisation.

The *Mweru-Tanganyika Biosphere Reserve* is composed of present NP's (that will become central areas), chitemene areas threatened by nutrient depletion and escarpment areas threatened by erosion. These will become transition areas, with restricted land use but also offering protection and new chances for the inhabitants. Because of its diversity of ecosystem types, the area may be feasible for tourism, including lake-oriented activities.

Recommendations for Nature Management Policies:
- Establishment of the three proposed Biosphere Reserves.
- Preservation of existing NP's.
- Establishment of new protected areas, in case of severe environmental problems.
- Training of wildlife guards, wildlife rangers, biologists and conservators.
- Nature education on schools.
- Extension of wildlife research.

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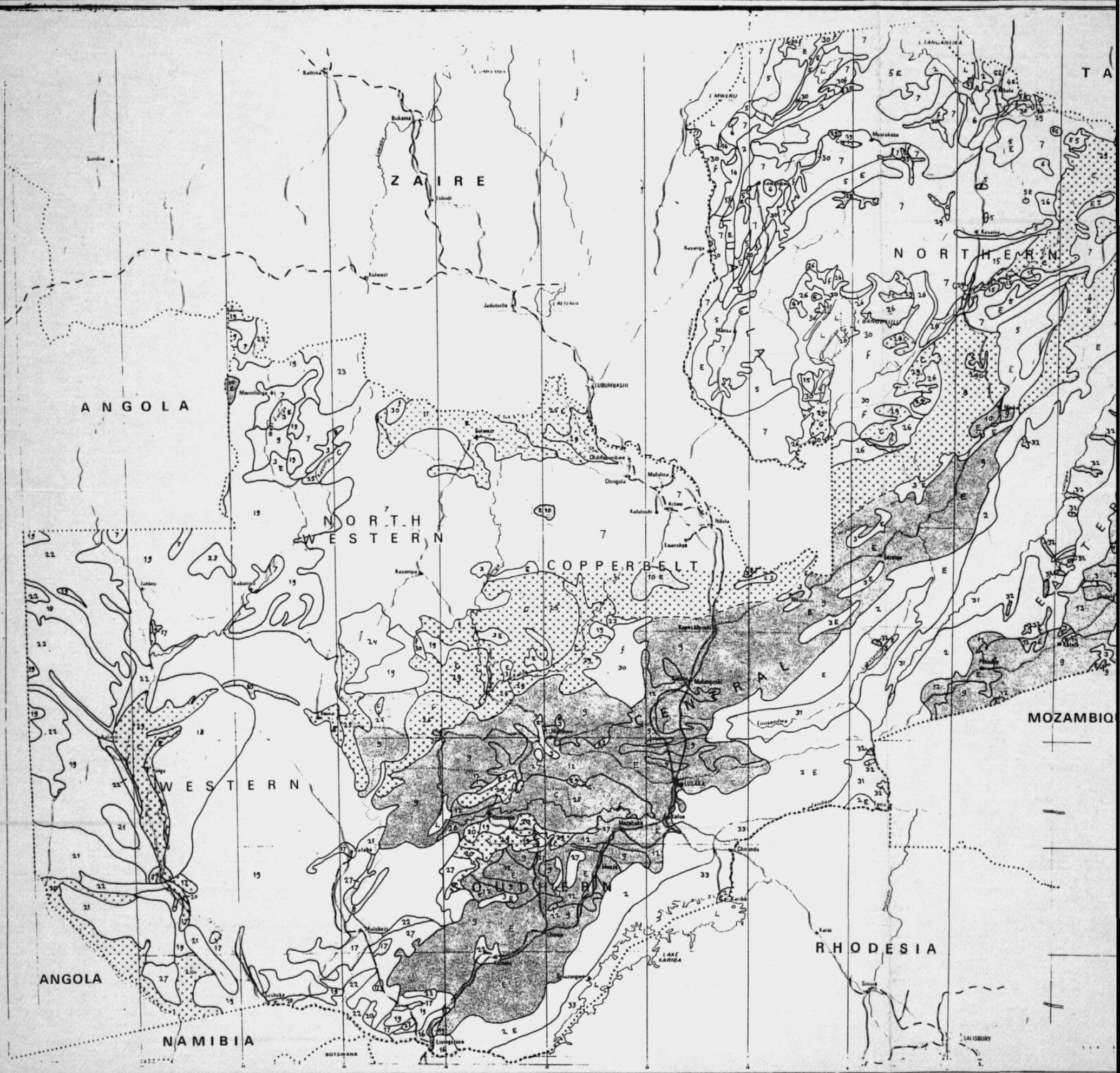
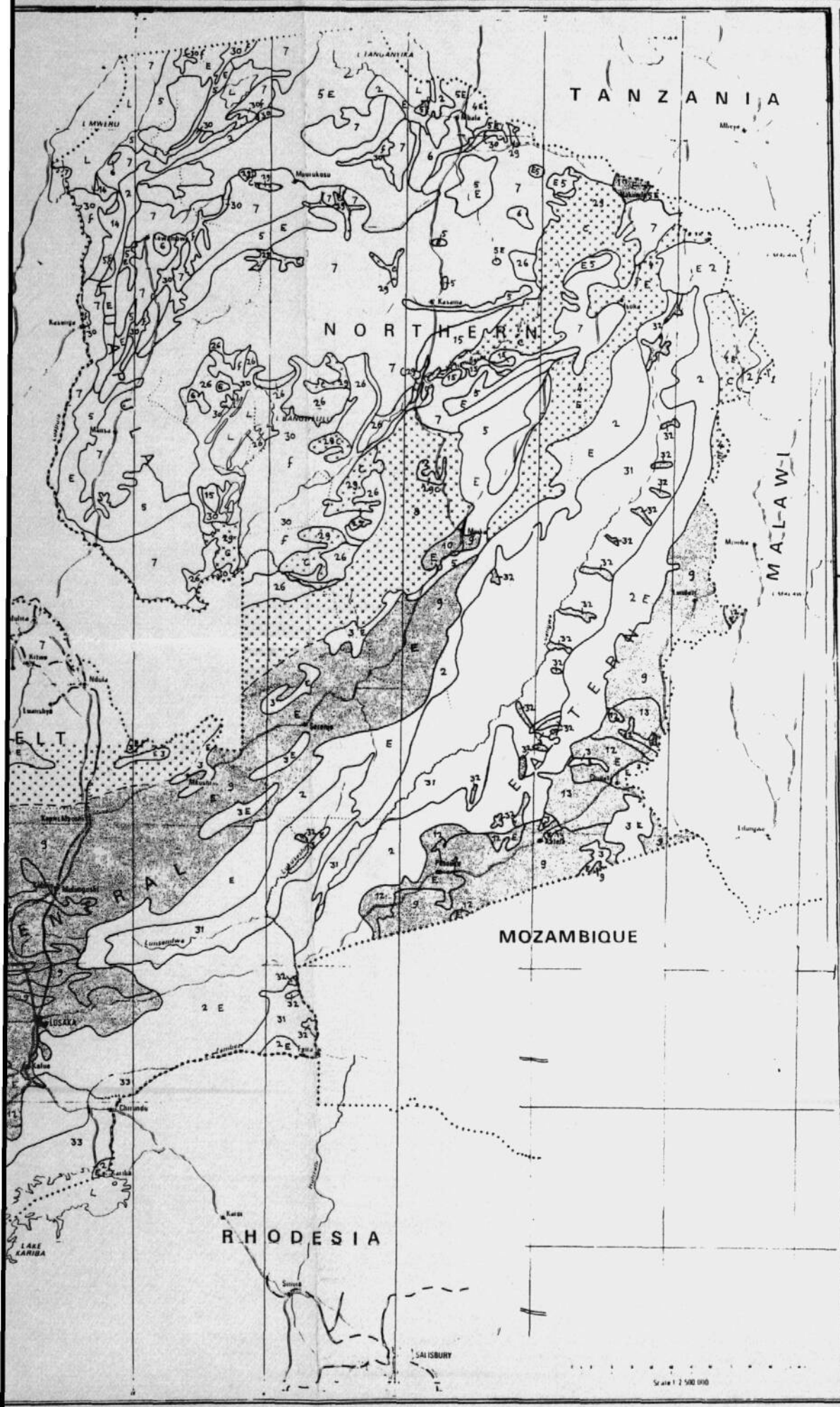
NCS ZAMBIA

SOILP



SOILPOTENTIALS MAP 1



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POTENTIAL PRODUCTIVITY FOR AGRICULTURE

	HIGH	C – ESPECIALLY FOR CATTLE E – EROSION RISK HIGH	9, 10, 12, 13, 28, 32.
	MEDIUM	C – ESPECIALLY FOR CATTLE E – EROSION RISK HIGH	4, 8, 11, 15, 17, 20, 25, 29.
	LOW	E – EROSION RISK HIGH	1, 2, 3, 5, 7, 14, 16, 18, 19, 21, 22, 23, 24, 26, 27, 31, 33, 6.
f	SPECIAL PRODUCTION POTENTIAL: FISH		30, Floodplains and watercourses.

DESCRIPTION OF SOILS (and natural vegetation)

high relief areas

1 Nyika plateau soils. Montane grassland
2 Shallow, gravelly soil (lithosol). Acid parent rock. Miombo.
3 Shallow soil
4 Association of 2 (50%) and 9 (50%). Acid to basic parent rock. Miombo.
5 Association of 2 (60%) and 7 (40%). Shallow or deep. Miombo.

low relief areas (eastern plateau)

6 Clayey, strongly leached, red. Acid parent rock. Miombo. Very low retention cap.
7 Clayey to loamy, strongly leached, reddish to brownish. Acid pr. Miombo.
8 Association of 7 (60%) and 9 (40%). Miombo.
9 Clayey to loamy, moderately leached, reddish to brownish. Acid pr. Miombo.
10 Clayey, moderately to strongly leached. Basic pr. Miombo.
11 Association of 7 (40%) and 10 (60%). Miombo.
12 Clayey, moderately leached, red to reddish. Basic or acid pr. Munga.
13 Association of 9 (80%) and 12 (20%). Miombo (9) and Munga (12).
14 Loamy, strongly leached, reddish. Acid pr, very low base saturation. Miombo.
15 Loamy to clayey, strongly leached, dark brownish. Acid pr. Miombo.
16 Shallow soils on basalt parent rock.

low relief areas (western plateau)

17 Sandy, red. Kalahari sands pr. Baikiaea.
18 Sandy podzols. Kalahari sands pr. Kalahari.
19 Sandy, non or weakly podzolic. Kalahari and Cryptosepalum.
20 Association of 9 (50%) and 19 (50%). Munga (9) and Kalahari (19).
21 Senanga-West Floodplain soils. Miombo ad termitary associated vegetation.
22 Hydromorphic sand plain soils or very poorly drained soils in large dambos. *Grassland.*
23 Association of 19 (65%) and 22 (35%).
24 Moderately well to imperfectly drained, shallow soils over laterite.

depressions

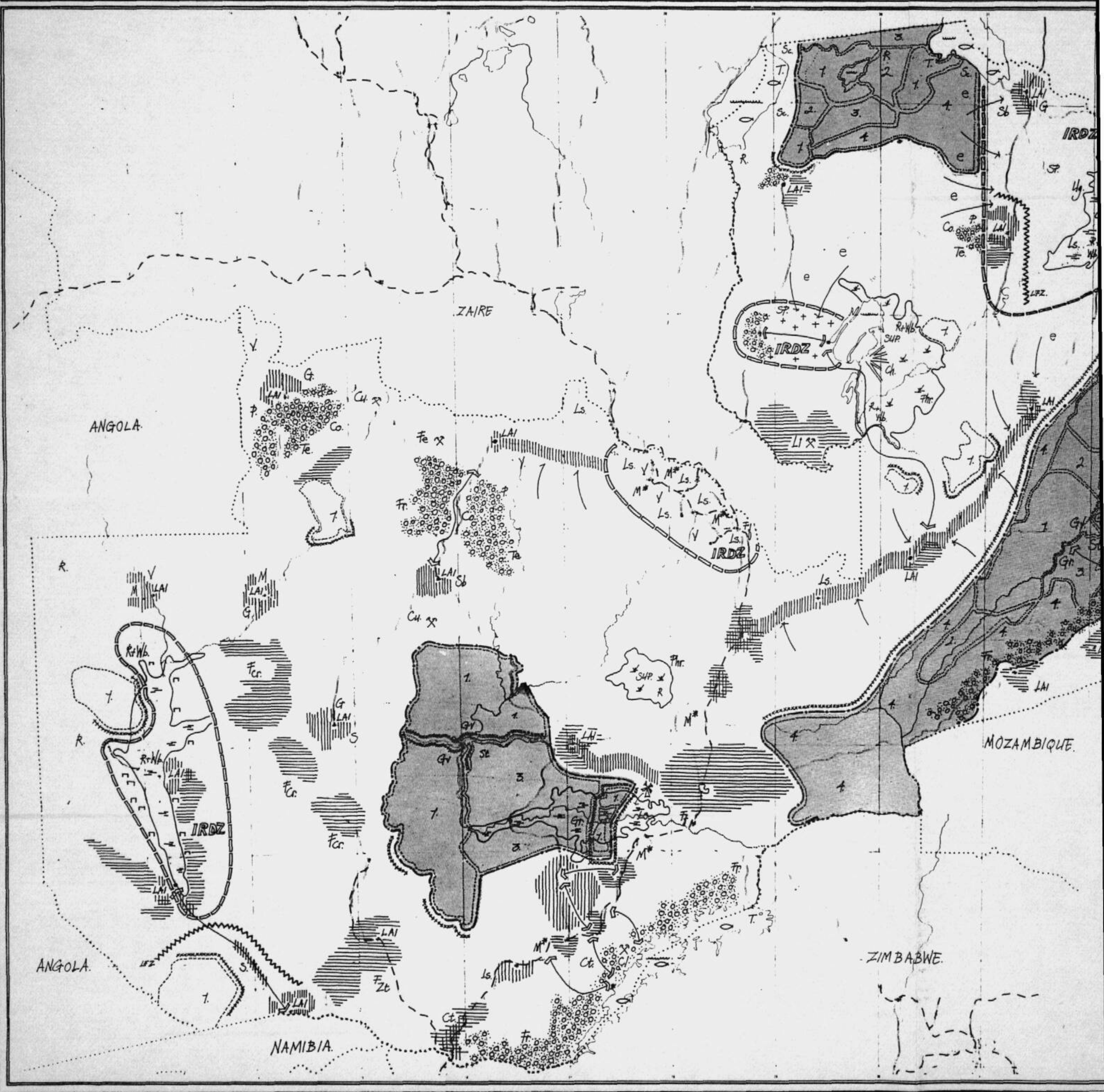
25 Association of 8 (40%9 and 29 (60%). Termitary associated vegetation.
26 Association of 7 (80%) and 29 (20%). Miombo (7) and Lake basin Chipya (29).
27 Swamp soils, black. Mopane.
28 Kafue flats clay soils. Grassland.
29 Floodplain soils. Termitary associated and grassland.
30 Swamps and swampy soils. Grassland.

rift valley

31 Luangwa, Lunsempfwa and Lukusashi valley soils. Mopane, munga, miombo.
32 Alluvial soils along tributeries in Lungwa valley. Munga.
33 Gwembe valley soils. Mopane, munga, Baikiaea.

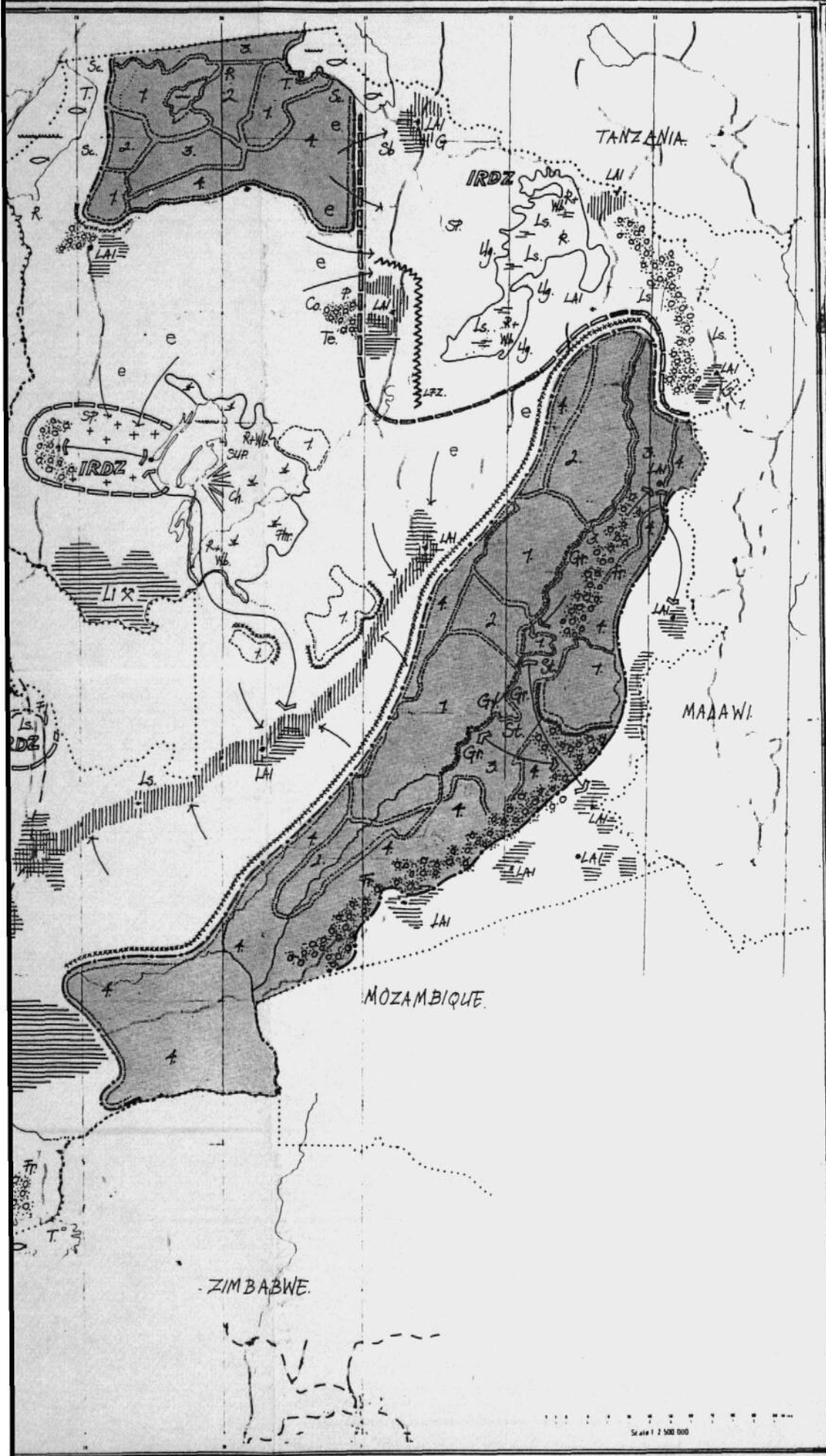
NCS ZAMBIA

NA



NATIONAL PLAN

MAP 3

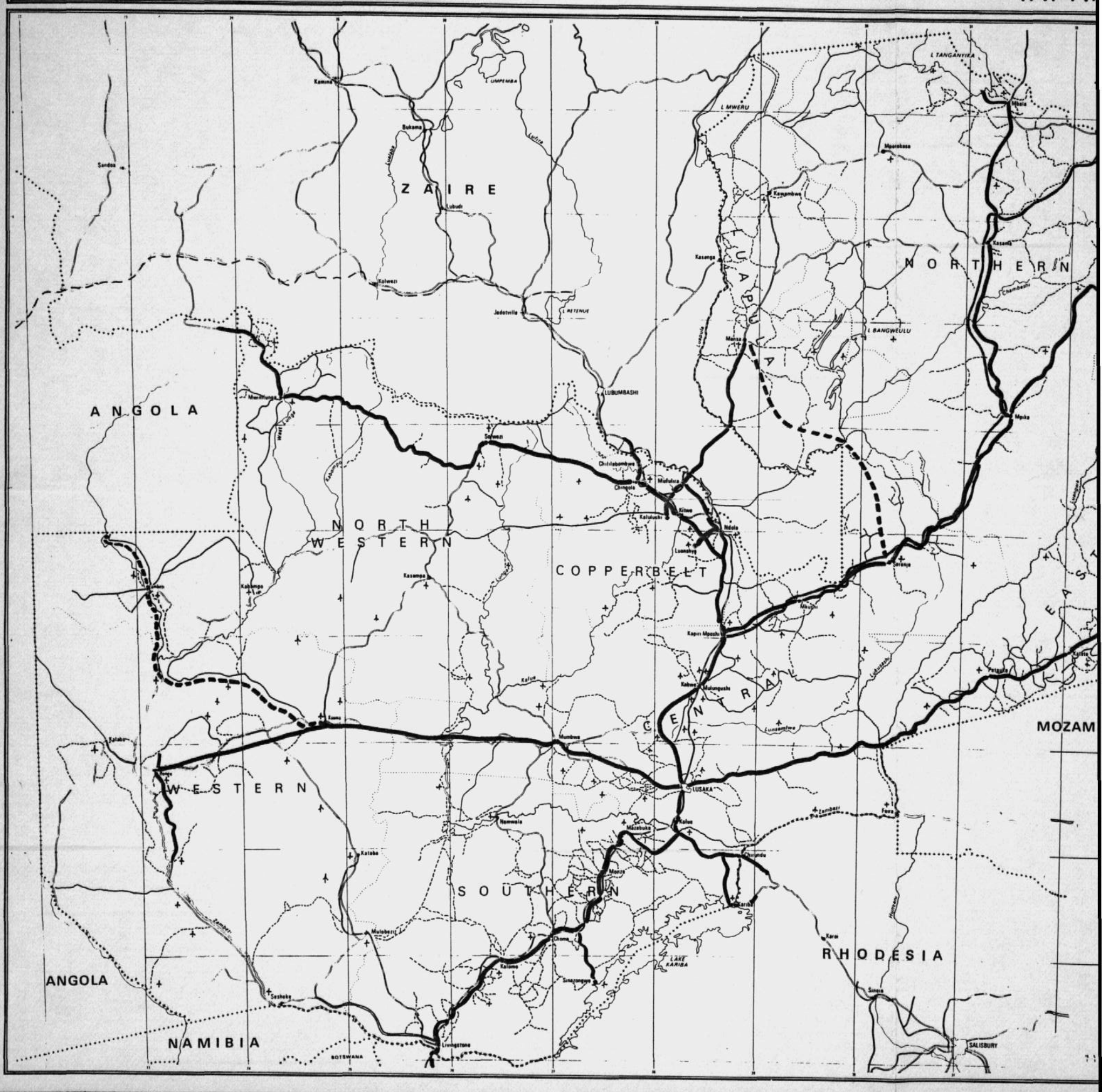


legend

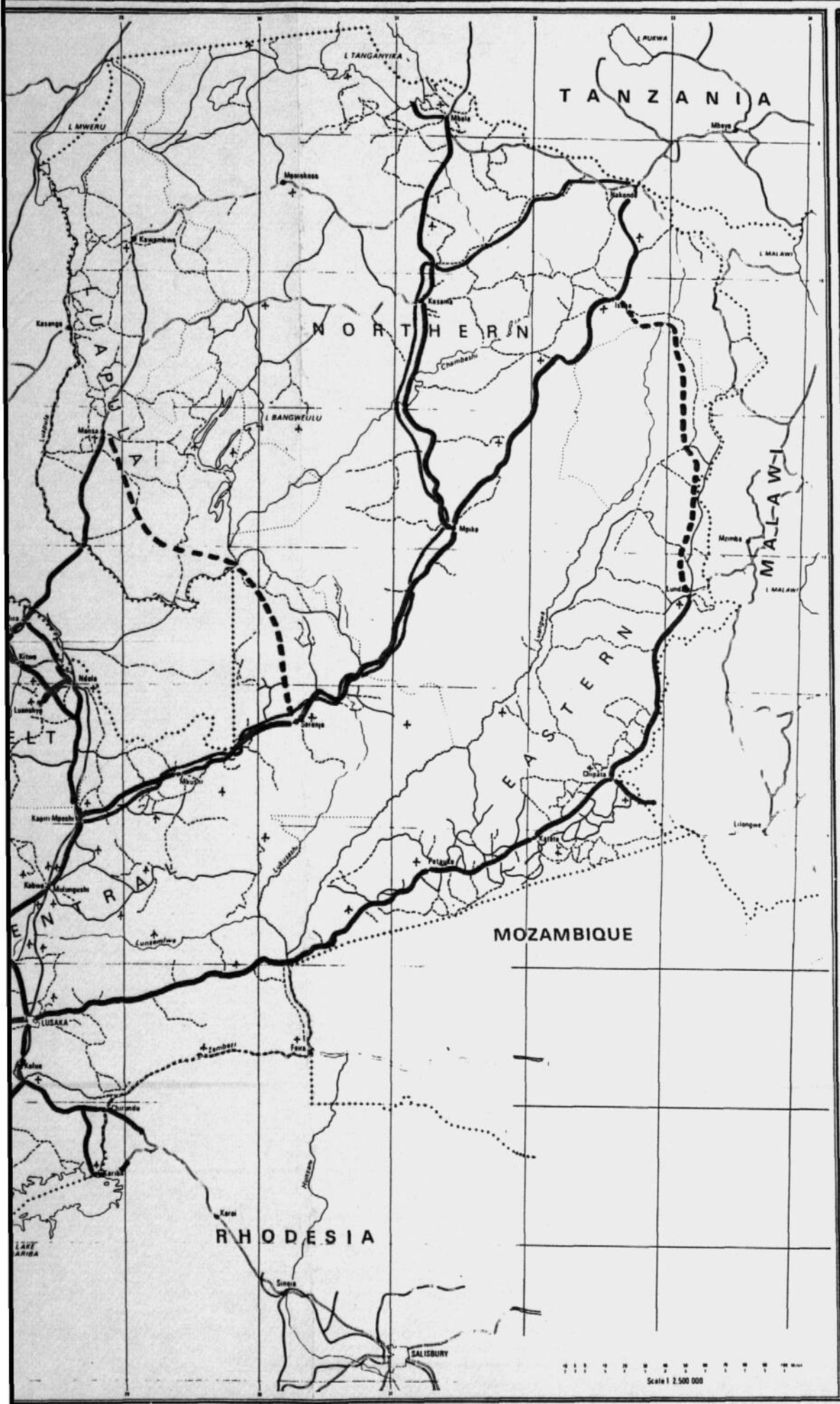
- AFFORESTATION
- COMMERCIALISATION OF AGRICULTURE
- AGROFORESTRY
- EXTENSIVATION OF AGRICULTURE/ZONATION EXTENSIVE INTENSIVE
- SUP — IMPROVEMENT NUTRIENT SUPPLY BY USING PEAT/SWAMP USE PROGRAMME
- LAI SP — LOCAL AGRICULTURAL INDUSTRIES/SETTLEMENT PROGRAMMES
- IRDZ — INTEGRATED RURAL DEVELOPMENT ZONES (= PROGRAMMES)
- Sc Fr — SPECIAL CROPS/FRUITS SC: MANGOS, PAWPAWS AND BANANAS
- Ug Ls — UPLAND GRAZING/LIVESTOCK (IMPROVEMENT)
- R + Wb — RICE+WATERBUFFALOS (INTRODUCTION)
- 1 2 — NATIONAL PARKS/PROTECTION ZONES CONNECTING NP's
- 3 4
- BIOSPHERE PARK
- DEVELOPMENT OF POLDERS/STIMULATION OF FISHERIES
- Gr Gv — GAME RANCHING/GAME VIEWING
- C — CROPS: G GROUNDNUTS, Sb SOYBEANS, Ct COTTON, S SUNFLOWER V VEGETABLES, P PINEAPPLES, Co COFFEE, Te TEA, M MAIS
- M* — HIGH YIELDING VARIETIES, MAIS AND OTHER CASH CROPS
- PROTECTION NATIONAL PARK/ LIVESTOCK FREE ZONE (LFZ)
- Cl Ph Fe Cu — MINING, COAL PHOSPHATE COPPER AND IRON
- Phr. — FLOODPLAIN, SWAMP AND PHRAGMITES
- Fcr. Fzt. — CRYPTOSEPHALUM FOREST/ZAMBIAN TEAK FOREST
- Ft. — FERTILIZER FACTORY
- T St — TOURISM/SAFARI TOURISM
- Ch — DREDGING OF CHANNELS/IMPROVEMENT OF ROADS
- MAINTENANCE OF DRAINAGE SYSTEM

NCS ZAMBIA

INFR



INFRASTRUCTURE MAP 2



legend

- TARRED ROADS
- TARRED ROADS (PLANNED)
- PRIMARY ROADS
- SECONDARY ROADS
- TRACKS
- RAILROADS
- AIRFIELDS