1 Description of the Case (the Pre-Knowledge of the System) & Research Design

1.0 Inventories, Form Factor & General Discussion on Sense and Non-Sense of Inventories in Yemen!

The aim of this chapter is, to explain that forest management under the given conditions needs to go a big step beyond inventories and monitoring. The methods and results of inventories have been described in detail in the reports on "*Jebel Bura" / "Jebel Lawz" - "Inventory and Technical Management Proposals", "Production estimates of 5 Plantations in Yemen*" and *"Sense and Non-Sense of Inventories in Yemen*". Here only the major methodological elements will be summarized, in chapter 4.1 - 4.3 the main results.

1.0.1 The Use of Aerial Photos

While in the early stages of inventories the aerial photo was very important to identify and delimit woodlands (Saadallah, Millington, Herzog), in the meantime the whole Yemeni woodlands have been mapped (1:50,000). Photointerpretation still plays a role in monitoring of developments (Millington, Bura'). But due to the extremely mountainous terrain (distortion, shadows), and the small scales of photos available (1:50,000, in few cases even 1:20,000) interpretation is very difficult. The verification of Monsch's forest map e.g. (s. chapter 4.2.2.1) shows clearly the overestimation of forest cover under conditions producing long shadows (north facing slopes in winter e.g.) and the underestimation of the cover on directly lit slopes (southern slopes in winter without shadows!) In the case of strong shadows, even a pure shrub cover of *Phoenix subserrata* and the like, classifies (virtually) as forest. While without shadows, even the dense riparian forest can be taken for bare land!
In any case, aerial photointerpretation, even more satellite pictures, need an extensive verification on the ground. With an average tree height of 5 to 10 m it is impossible, even with 1:20,000 photos, to determine tree height and crown diameter on the photo. At least 1:10,000 or even 1:5,000 photos would be needed, what is rather expensive and probably not worth while, given the low biomass.

1.0.2 Plot Size and Shape

The optimal size and shape of plots has been tested by Bormann. His recommendations are [1]):
a) Some form of rectangular plot should be used.
b) The longest axis of the plot should cross any observed contour, soil, or vegetational banding.
c) Samples should be laid out in a random manner to eliminate

[1]) Ecology, 34 (3), July 1953. p. 474-487. Rec. from p. 487:

personal bias and to allow the data collected to be treated statistically, if desired.

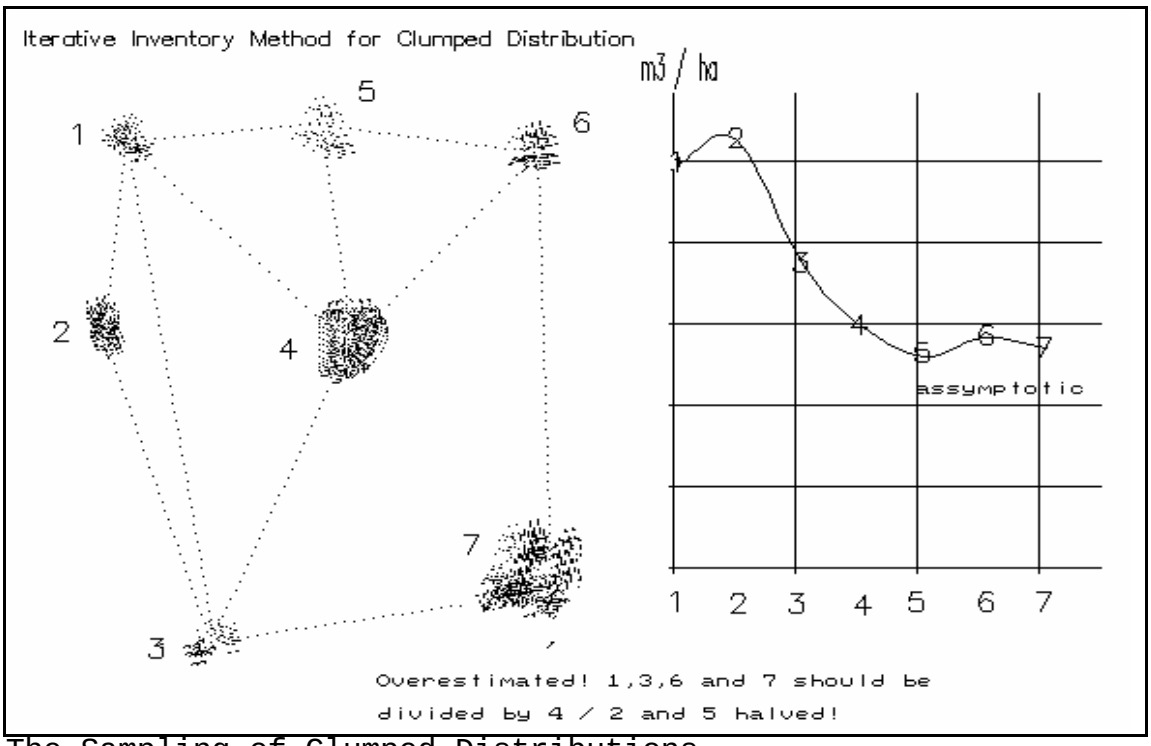
d) The number of plots generally used at the time (1953) should be increased. The number will necessarily vary with the individual stand and the sampling precision desired. In Bormann's trials the sample covered about 14% of the total area, the ideal size determined was between 4m x 140m and 10m x 140 m!

To stake out a square plot of 20m x 20m has taken about 3 hours (!) at Jebel Bura' As the visibility is zero, the dense shrubs have to be cut all along the borders of the plot. Long, rectangular plots would make even more intense clearing necessary. As this forest is (hopefully) going to be a national park - that idea had to be given up.
The same is valid for an other method used in tropical forests: "line taxation calipering" (should be about the term for the German: *Linientaxationskluppung*), where along a transsect all vegetation is cut down and height, diameter, form-factor, volume can easily be determined. For reasons mentioned above, this can't be done at Bura'.
In Switzerland nowadays permanent circular plots with constant size (= diameter adapted to inclination) are used. The constant size eliminates variability due to plot size. On the other side it leads to larger plot diameters in difficult (steep) areas! So for our inventories we finally choose **circular plots** with a **fixed diameter of 15m** (: size varying with inclination). Circular plots are most easy to mark out and cause a minimum of destructive undergrowth clearing.

1.0.2.1 An Approach for Clumped Distributions:

Yemeni woodlands, even "forests", have a very low density. Closed forests with a crown cover of over 50% just don't exist! A "real" forest in Yemen, as e.g. Jebel Bura', has a crown cover of about 20% - not considering shrubs and bushes, only trees! Even inside this 'dense forest' the biomass is very unequally distributed. It is heavily clumped. Some enormous *Ficus* make up 80% of the volume, while large areas of shrubs and Acacias represent only a very low biomass. This clumped distribution is even much worse and visible in the 'open woodlands', mainly the *Acacia-Commiphora* stands and the agroforestry lands. A few individual trees or small woodlots are distributed over a large area. For inventories of this type of woodlands a "cluster analysis type" of inventory will be preferable. Steps (s. following graph):
1) Measure cluster no 1
2) Measure distance and angle (azimuth) to cluster 2
3) Measure cluster 2
From the 3rd cluster onwards the included tree-bare area can be determined. Each tree volume on the borderline will be calculated 1/2, trees on corners 1/4. The position will change from step to step. While (see graph) for step 5 and 6 plot 4 will be calculated 1/2, with plot 7 a large area will be added, but as well the remaining 1/2 biomass of plot 4!

While the first 2-3 clusters will overestimate the volume/ha, from the 4th onwards the average density should get asymptotic. The cluster number has to be increased until the change gets marginal! This approach minimises needed plots and optimises the plot size. For the national inventory the time spent to reach the plots will be the most important factor. With a minimal plot number time and money spent will be minimized as well.



The Sampling of Clumped Distributions

1.0.3 Volume - Form-Factor

To estimate the volume of standing trees the simple formula: basal area x height x form factor is used. The first mass inventories done by Saadallah in 1988 used the form factor 1 (cylinder), the inventories of the author used a form factor of 1/3 (conus). Measurements were done section-wise on the floor, and as well on the standing tree, determining the Pressler Formula with the Bitterlich-Relascope. The empirical form-factor is varying from 0.3 for Eucalypts to 0.8 for Ficus. An average of 0.5 for first and rough estimates is appropriate.

1.0.4 Increase Rates

In Yemen only *Juniperus excelsa*, a tropical high mountain species, forms year rings (- besides the fruit trees as almonds, peaches, apples ..., whose wood proofed too hard for the core sampler!).

The only alternative would be to use periodic inventories - every 5 to 10 years - what is not promising due to the high variability and the costs. A more recommendable method would be measurements of individual trees in relatively short (yearly) cycles, using microdendrometers. *Forestry Suppliers inc.* (USA) had one, where three screws have to be fixed in the tree: Then periodically with one to several years interval (!), the cambium increase may be measured. (Unluckily we never succeed to receive a complete and functioning instrument). The German products of *Walz*, have to remain fixed at the tree, and are rather meant to measure daily and drought induced fluctuations of stem diameter. Moreover they are rather expensive (some US$ 2000.- a piece) and can't be left unguarded in the forest.
What would be needed is a device allowing for simple increase determination on trees that show periodic growth during the rainy season - but no reliable ring formation. It should be easy to handle, not too expensive and should allow to measure large sets of trees (statistically representative samples) in a reasonable time, as the device described above.
An other way to determine increase rates is to use plantations of known age [2]). Unluckily files on earlier established plantations have either not been set up, or have been lost.

1.0.5 Phytosociological Vegetation Description (Braun-Blanquet).

Phyto-Sociological classification in semiarid zones shows some specific problems. Water & salt are the dominating factors. pH, soil temperature, organic matter and biotic factors are of minor importance: *"In other words, under desert conditions the ecological factors controlling the composition of the community are fewer in number or have less efficiency."* [3]). This is mainly due to the following factors:

- overlapping of communities, esp. annuals, due to the dependency on rain
- ubiquity especially of annuals due to the dependency on moisture
- a strong segmentation of the units due to the wadi systems
- due to large barren areas the estimation of coverage is difficult
- moving sands function as mulch or might be blown away from the plants - what strongly increases variability
- there is a floristic drift through wind seeding and floods
- free admission of annuals

For the phytosociological inventories the following criteria were used:
1: Abundance (Braun-Blanquet): 5 classes from 1 (little) to 5 (very much)

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[2]) s. Herzog, M: *Productivity Estimates of 5 Plantations in Yemen*. FAO Yemen 1990.

[3]) Zohary (1973) p 401:

2: Dominance (after vegetation- (crown-) cover) (Braun-Blanquet, improved by Reichelt & Wilmans (1974), Weger (1974), Barkman (1964), Westhoff & Van der Maarel (1973):

r: rare, 1 individual in plot, in environment less than 1% .

+: sparse, 2-5 per plot. Less than 1% cover.

1: numerous, 6-50 individuals with small cover or less individuals with higher cover. Cover in any case less than 5% .

2m: very numerous. more than 50 individuals per plot. Co-v-er less than 5% .

2a: individuals ad libidum. Cover 5-15%
2b: " " Cover 16-25%
3: " " Cover 26-50%
4: " " Cover 51-75%
5: " " Cover 76-100%

3: Importance (Curtis 1947, Mueller-Dombois & Ellenberg 1974)
= 1+2 = Abundance + Dominance
ev. rel. values (in %, ads up to 200 % !)

4: Constance: Number per plot
ev in % (frequency)

In our case additionally the bhd, height and crown diameter of trees and shrubs were measured to allow an estimation of the volume and coverage.

1.0.6 Discussion: Objectives and Limitations of Inventories

An inventory serves as planning base for management! The main point would be the determination of the annual harvest allowance - that should be more or less equal to the increase rate. It depends on the stand's stoking biomass and structure, but as well on environmental factors (soil, water).
Some technical problems of shrubland inventories have been mentioned above. The major statistical and financial problems are variation and precision.
At Jebel Lawz a systematic grid with a spacing of 200m x 200m was chosen, what makes 1 plot for 400m^2. The plots are circles with 15m radius, what gives a maximum representation of 1.8%. At Bura' the grid had to be halved: 400m x 400m, what means only 1 plot on 16 ha, a maximum representation of 0.44%. At Bura' the plots where marked permanently and mapped. Each tree's distance and azimuth from the center has been measured and registered.
The variation is in both cases quite high. If we calculate the needed plot number to get a precision of 20% only, we need in both cases about 1 plot per ha! For Lawz this would mean 4 times the work done, for Bura' 16 times!
At Bura' the average of plots that could be installed and measured per day was just about 1 plot (permanent)! At Jebel Lawz 4-6 can be done (not permanent) because the access is easier due to the absence of underbrush and thorns.

Costs: From the point of view of expenditure, already an inventory with 20% precision is not feasible (**300 ha** = 300 plots = 1 year for expert, counterpart, driver and car!).
And the main point: Let's say at Jebel Lawz we have an annual harvest allowance of 12 m^3 of Junipers, 4m^3 of Acacias and 48 m^2

of Almonds and Junipers from the terraces = $64m^3$! - for the whole mountain forest area of 264 ha!
At Jebel Lawz overuse is not that bad, as cutting junipers is principally forbidden, permits are issued by the sheikh for house constructions only! At Bura' the situation is worse. The total biomass has been estimated as $4500m^3$ (ff=0.33) will have to be raised to $6750m^3$ with the more realistic (ff=0.5). But:

a) nobody has ever properly determined the increase rate!
b) there are 27 villages around this forest of 300 ha - and no control!

Effective needs for action:

Jebel Lawz: Due to the low productivity and the low density, there is not sufficient wood and fodder being produced. Besides protection - plantations are needed - but only where they are possible without irrigation!

Jebel Bura': This forest is overused and mined by wrong harvesting methods! Even as the natural regeneration is still very rich all over the forest, due to the selective wood-cutting of poles, the potential productivity is not optimally used. There is an urgent need for management, what means before all awareness raising and a clear attribution of rights and duties to individuals and communal bodies.

Wadi al Aswad: Regeneration can only survive in vegetation clumps, where it is protected by thorny shrubs and Euphorbias. Amenity plantations have been very successful under those conditions and the trees have been taken care of. Afforestations for fodder production and as bee range have been welcomed and partly successful - but the protection proofed very difficult and expensive (2000$ / ha), due to the needed fencing.

Agroforestry (*Dobera*) at Hazz: Only old, mostly overaged trees remain. Only Ziziphus is regenerating well. Other trees need heavy protection.

Acacia stands: As long as the Acacias are lopped or pollarded, the trees will be protected by individuals and villages. The fact that coppicing is less advantageous for the regeneration of the trees is known by the people. The reshoots of coppiced trees are very tender and eagerly browsed by animals!

Eucalypts do very well along roadsides, where they get some additional runoff. But as they are very competitive and fast growing, they have to be planted in secure distance to fields, roads and houses!

From those practical examples it gets quite clear, that forest inventories in Yemen don't fulfill what they are thought for. In the developed countries where inventories and harvesting is done by the forestry service itself, annual increase and harvest are known. In Yemen wood harvest can't be controlled! Inventories are terribly expensive and still inaccurate. Inventories do not serve for much more than for monitoring. So they should be limited to protected areas and seed harvest stands!

A systematical approach to the real practical and true problems of forestry in Yemen has to answer the questions [4]):

what - why - where - who - when - how

what: The result of all inventories indicate clearly a need for protection of existing woodlands, a need to protect and enhance regeneration, a need to control harvest.
why: The inventory indicates a lack of regeneration, or rather a rapid disappearance of regeneration and poles and an unequal distribution of tree diameters, height and ages.
where: The inventory determines the actual size and extent of woodland, what can be used for monitoring and indicates areas with lacking (fuel-)wood supplies.

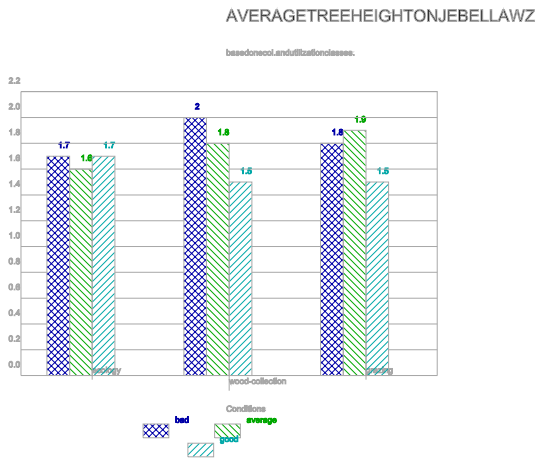
But - that is all we get from the technical approach.
While such a causal *why* means something for the forestry expert or environmentalist, it doesn't mean much for the farmer. For most farmers in Yemen, trees, especially natural trees, are a gift of God and He takes care of that!
Where to plant trees is not an easy question either! Yemen is quite densely populated - taking into consideration, that the bulk of the population lives from agriculture! Most land that has some good topsoil - and available water! - is used for agriculture, the rest in any case as rangeland. This implies quite high protection costs for the
How: The forestry project concentrated on agroforestry. Here the main advantages are, that:
- farmers are already aware of the need of trees for windshelters,
- water and land is available,
- browsing can be controlled as the trees grow on farmland.

But - **agro-forestry** (including date palms) covers only **18%** of the total woodland resources of Yemen! There is a lot more to be done!
As the why is not quite convincing for the farmers, some additional incentives, wages, ownership (or user-) rights are needed for the ***Who*** - to successfully establish user groups that are willing and able to assume responsibility - the aim of social forestry.
The ***when*** is clearly in march/april and july/august, just before and during the rainy season - what is unluckily the period when the farmers are quite busy with their farmwork!
The dominant problems of forest management in Yemen are so problems with the why and who, problems with the actors, the human users of the forest. This fact will be shown as result of an inventory in the following chapter:

[4]) s. chapter 2.3.3.1 Topics

1.1 The Dominance of Humans, of the Socio-Economic Factors over other Ecological Factors.

For the inventories at Jebel Laws [5]) the factors altitude, exposition, inclination, as well as some other "dummies" (-1/0/1) classifying water availability and the accessibility for humans and sheep, have been checked graphically and regressionwise. Both show (s. following graph), that the only really outstanding factor is the wood collection, followed by altitude, inclination, grazing and exposition. The factor "ecology" (integrating soil depth, water availability) does not improve the regression much.
The better the accessibility of an inventory plot, the lower is the tree height. That the factor grazing shows about the same tendency, might indicate a collinearity of factors as the shepherds collect wood preferably near the grazing areas. There is no influence of browsing. Neither sheep nor goat browse on Junipers. Their might probably be some minor influence through soil compaction.



The same fact can easily be shown by phytosociological descriptions (Wadi Bussal e.g.) and other inventories (Jebel Bura' e.g.). Both show a strong decrease of variability the closer the plot is situated to a village or road.
This fact, the dominance of human influence over natural ecological factors, is in fact neither new nor something specific for Yemen. It has been described for the Mesopotamian range already

[5]) Herzog,M: *Jebel Lawz: Inventory and Technical Management Proposals.* FAO. GCP/YEM/015/SWI. Sana'a. August 1990. p 30:

in the beginning of this century. In general it seems to be quite impressive in the whole Arab world, as there is the cradle of civilisation and the impact of agriculture lasts already for over 5000 years! After Zohary [6]):

1) The effect of man as ecological factor is as strong as climatic alterations in some past geological periods.
2) Man's impact on vegetation was in certain aspects stronger than all other ecological factors together.
3) Instead of separating man as an unnatural, alien element in ecology, "*include man within the primary ecological complex of factors affecting nature*".

Especially the third point seems to me quite important and had a major influence on the layout of this research project. In more formal approaches the influence of socio-economics can be derived even quantitatively by factor analysis [7]): *"This study ... showed that the socio-economic indicators where probably the most useful comprehensive source of data, since they defined most of the sources of variation."*

Francis Bacon had recommended: *"If we want to understand nature, we have to study nature rather than Aristotle and other old books."* In analogy to that we should say nowadays: **If we want to understand the relation of the humans to their environment, then we have not only to study the nature, but as well the *humans - and their system of values.*** That is the aim of applied sciences in general, as e.g. [8]): *"Range management can be considered as human ecology, involving not only the biological principles, but man's institutions, his technology, and his culture as well".*

Moreover the weight should shift from observations of "states" of the environment to the direct observation of processes, that means of direct or indirect human action. Traditional monitoring is deriving processes from changes in the state between two inventories. Given the rapid degradation of environment - and the need to get direct information on the destructive processes themselves - a more direct insight is needed. It should focus especially on the possibilities to control and reverse the degradation.

1.2 Social Systems, their Analysis and Steering

The actual systems analytical methods, as *farming systems analysis, agroforestry systems analysis, diagnosis and design, community forestry* - while having different objectives, use the same set of surveying methods (RRA - Rapid Rural Appraisal), belonging in fact to qualitative sociology (s. chapter 2.3). They

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[6]) s. Zohary (1973), Vol II, p. 610 f.:

[7]) Davies (1984) p. 90:

[8]) Stoddart p. 91:

deal with rather well defined and delimited small scale system; basically with communities and families.
The problem of the COMMON LANDS, on which most forests (more precise: woodlands) are stocking, requires the enlargement of the (social) system to a larger scale as tribe or state, who most often are the owners of forests. The impact on this kind of areas can only be regulated if some steering principles can be found, that really have an influence on owners and users (not always being identical)!

1.2.1 Social Forestry

The fact that de-forestation proceeds much faster than re-forestation (by natural regeneration as well as by plantation) is calling for urgent action on a large scale. The forest users have to be motivated to get involved personally, to start reforestation. The precondition for that is [9]): *"Projects must be culturally acceptable, that is, understandable, agreed to, and capable of being operated and maintained by the local social actors and their institutions and organizations."* SF integrates traditional tree management practices (IK) into its concept, as pollarding, coppicing, pruning; but keeps an eye open for eventually needed improvements or adaptations, that means project interventions, in cases where traditional management systems either don't exist or are threatened due to population increase and influx of people from other areas.

1.2.1.1 Definitions of Social Forestry:

"The concept of **social forestry** as a strategy in forestry work was introduced as early as 1973 in India where precise goals were set for the new approach: "*I found relatively early use of the concept "social forestry" (perhaps the earliest use in an important government program) in the* ***Interim Report of the national Commission on Agriculture and Social Forestry*** *prepared in 1973 for the Government of India (...). "Social forestry" was proposed and advocated in that report in contrast with, and as an alternative to, what was then called "extension forestry"; the latter was criticised as inadequately meeting the "social demands on forests"* [10]). The objectives specific to "social forestry" where defined in that report as follows:

(i) fuelwood supply to the rural areas and replacement of cow dung;
(ii) small timber supply;
(iii) supply of grasses and fodder and provision of grazing;
(iv) protection of agricultural fields against wind; and
(v) recreational needs. [11])

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[9]) Cernea p. 19:

[10]) Cernea: "*Putting People First. Defining Social Forestry*" p. 341 / p 10 of quoted report:

[11]) ibid after p. 12 of quoted report:

Since then, a broad consensus has developed on the objectives of social forestry. The current concept of **social** forestry recognizes that such programs must be designed to motivate large numbers of **people** to plant trees, promote the kind of tree growing that will best supply fuelwood, small timber, grasses, and income to the small producers themselves, and provide increased benefits to the poorer strata (uba). Social forestry programs are primarily aimed at involving the farmers and the landless. They attempt to influence the key variable - a variable usually bypassed in the design of conventional afforestation programs: people's **behaviour** towards trees! *"Furthermore, the social in social forestry should be understood to signify a broader meaning than individual behavioural change alone: it includes collective action, institutional development, and the establishment of enduring social structures and value systems that activate and organize individual actors."* [12])
The activities proposed are almost classical, what is new is the emphasis on the social factor, neglected in former approaches: *"Therefore, the social and cultural issues involved in forestry projects, particularly in social forestry, are every bit as important as (a) the economic issues, (b) the technical issues, and (c) the environmental issues*. (uba) [13]) There is a clear link between SF and policy work: "*Social engineering consists of attempts to use the cody of sociological knowledge in the design of policies or institutions to accomplish some purpose. Social engineering can be accomplished for a mission-oriented agency of for some group opposed to the existing organisational structure, or it may be undertaken separately from either .... When conducted close to the policy-making centres, it is often termed social policy analysis ... When practiced by groups in opposition to current regimes, social engineering becomes social criticism."* [14]).

1.2.1.2 Critical Experiences:

Social forestry was not and is not in any case and at any rate a success. Many difficulties have been encountered. Methodology and aims had to be - and will have to be - adapted over and

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over. The first and major problem was and is the identification or creation of a social unit that is able to assume responsibility. The following definition describes social forestry as almost identical with community forestry: "S*ocial forestry (also called community forestry or agroforestry*) *is a broad term covering roadside strip planting, community woodlots, farm forestry, and tree planting on marginal lands by the landless. The novelty of social forestry lies in beneficiaries' direct involvement in tree planting and management. This effort, however, has not yet been very successful.*" [15])
SF uses the 'enlightening' (extension) approach for awareness raising, but considers it as clearly insufficient, as the operationalisation of social knowledge for action is lacking. SF calls for organisation building at grassroots, as *"All over the world, the degree of formal organisation in rural communities lags far behind that of urban populations*" [16]). For that purpose the assistance of higher level (governmental) institutions can't be neglected: "*Rural transformation essentially requires changes in farmer's behaviour, motivations, and expectations which is hardly possible until institutions exist to provide them with increased production possibilities and incentives.*" [17]) *"Implementation of forestry projects need a clear framework for relating the socio-organisational and the technical work at each step of a project so that the field-level technical and organisational staff and the farmers understand their respective role"* [18])!
The need to work with social organisations arouse as soon as forestry moved from governmental forestry and agroforestry to THE COMMONS. While governmental forests might well be used and/or managed directly by the national forestry service, agroforestry and community forestry needs the direct involvement of individuals and small local groups. The trend was for a while to work with the 'owners / administrators' of those COMMONS, but experience showed that some of the basic assumptions did not hold true [19]): "*I argue that community woodlots* ***cannot*** *be effective as such because woodlot schemes inspired by the romantic myth of homogeneous communities are misconceived from the outset and because appropriate social actors and social arrangements have not been put in motion." "To propose a generalised formulation, there are seven basic socioecological reasons why "communities" as population clusters cannot and should not be treated as ready-to-use corporate actors (units of social organisation or economic agents) for afforestation programs:*

1. *Communities and villages are geographical residential units, not necessarily corporate organizations. Physical vicinity alone is not sufficient to engender the type of long-term collective action required for a woodlot enterprise."*

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[15]) ibid p 309:

[16]) ibid. Aaron Wiener, ICIDD Bulletin. p. 26:

[17]) ibid. D.M. Freeman & M.K. Lowdermilk. p. 113:

[18]) ibid p. 103:

[19]) ibid p. 366:

2. *The interest of community subgroups often differ to such an extent that the kind of collective action required by a long-term afforestation program is generally not possible. Usually, communities are heterogeneous population clusters, stratified and split into factions and sub-groups with fragmented socioeconomic interests. What is advantageous for one subgroup is not necessarily advantageous for another."*
3. *Community land is limited and often there is reluctance to make it available for tree planting. Tree block sites are small, costs are high. The poorest households have a vested interest in not allowing the commons, which to them are a continuous, even if meagre, source of products, to become a closed and not accessible woodlot. As Jodha's research in India has demonstrated, the poor households are dependent on products from the commons much more than those that are better off.*
4. *The tenure status of the common lands is often uncertain and engenders uncertainty about the tenure of planted trees. It is similarly unclear what social body has jurisdiction over the allocation of common lands.*
5. *Authority systems have uneven power over community subgroups. Local community leaders often appear reluctant, or not strong enough, to mobilize the individuals belonging to different subgroups to work for establishing woodlots, or to enforce restrictions to protect the trees."*

Those general impressions reflect perfectly well the situation of the common lands in Yemen. The self-criticism of Cernea is by no means astonishing, given the complexity of the task and the social and political hurdles to be taken: *"Therefore, afforestation strategies or projects must start with the identification (or the establishment) of such a viable unit or group; aim to engage the rural users of fuelwood in patterns of collective action for producing the fuelwood they need; tend to ensure a match between the sylvicultural technologies they promote and the social groups they address; and deal with the issue of* ***social*** *engineering (group formation, leadership, participation in decision-making, intragroup structures, incentives, penalties, communication, benefit distribution, and so on) with the same scrupulous attention given to the technical or financial element of the strategy. Group formation is an acute need particularly in development programs that involve (even to a small extent) natural resources that are either (a) under a common property regime or (b) lend themselves to group management even if they are under a state property regime. To ensure both the immediate use and the long-term renewal and sustainability of a commonly owned natural resource, the owners must act in consensus as a group that subjects itself to the same norms.* [20]*) "The basic sociological principle is* ***to create a clear link between a well-defined small group and a well-defined piece of forest land*** *that is to be protected or planted. In additions, the group members need to perceive a clear correlation between their contributions and the returns they get, and with this*

[20]) ibid p. 345:

awareness be prepared to act consensually. Authority and benefits must be restricted to the members of the group, not left open to free riders." [21])

More promising than communities for the execution of forestry projects are [22]):

a. Natural (existing) social units, such as individual family household or a tightly knit kinship group or subgroup.

b. Groups organised purposively to plant, protect, and cultivate trees.

c. Groups established for other purposes than forestry, but able to undertake forestry-related activities as well."

The demands on the function and cohesion of a group are very high: *"In order to act as a group, they need to* ***be*** *a social group, not a simple set of unlinked individuals. Intragroup connections are forms of mutual conditioning, mutual help and mutual control. The absence of structures and strictures leaves open the way to unchecked, contradictory, and counterproductive individual behaviour such as free riding. This is the opposite of common property as a social construct and leads to the destruction of the natural resource itself.* [23])

> *"In forestry development, as often in natural resource management, strategies are needed that would, first, organise the individual users of natural resources into* ***groups*** *and second, enable such groups to act as* ***producers*** *and* ***managers*** *in order to generate increased benefits for themselves."* [24])

This leads to a big question-mark:

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CAN SOCIAL STRUCTURES BE CREATED ON REQUEST?

1.2.1.2.1 The Possibility of Establishing Social Organisations or Institutions by Social Knowledge?

The need to identify the actors for forestry and afforestation projects is clearly given - be they individuals or social groups. It was as well the reason for this study. It is understandable and acceptable that development projects need to be, up to

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[21]) ibid p. 380:

[22]) ibid p. 358:

[23]) ibid p. 345:

[24]) ibid p. 340:

a certain degree, interventive [25]): "*When technical specialists, economists, or managers decide on a development program without so much as consulting a social scientist, they do ad hoc social engineering of their own. When subsequently they implement that plan, they again do social engineering"* (uba). This is a clear obligation for democratic, participatory approaches. Still, the aim to create social units, based on sociological knowledge, might be set a bit too high: "*The social engineering action model is rooted in knowledge of the social fabric and dynamics. It postulates the translation of social science knowledge into new know-how and change tools, and it uses this knowledge purposively to organize new social action and relationships.*" The social sciences overestimate a bit their potential, and they move into fields that have not much to do with science: "... *it was on the crest of radical thinking and revolutionary action that the very idea of social engineering and of the perfectibility of the social order first arose - namely, at a time when "it was ... novel to think that human happiness can be* ***engineered*** *by changing the social order.*" [26]) In the course of time it got clear to social foresters that social groups can't be developed theoretically, but that it is a cumbersome, iterative process of trial and error, of participatory learning [27]): *"Practical recipes for* ***how*** *to incorporate these social prerequisites into action plans are not readily available. Culturally informed forestation strategies have to be produced, tailored, and retailored anew for each socioecological context. For that, foresters, planners, and action-oriented sociologists and anthropologists have to cooperate, search, predict, design, test, monitor, learn, redesign, and retest to combine effectively the technical and social approaches into coherent reforestation programs (...). In the quest for creative* ***new*** *solutions, much of the already existing sociological know-how can be mobilized and used as a stepping stone to action, testing, and new knowledge. There is no justification for sociologically illiterate social forestry programs."*

Before humans will establish one of those high targeted groups, they will have to see the sense, purpose, aim and common interest behind it. Any kind of organisation takes up some efforts in the establishment as well as in the maintenance. Any institution will restrict the individual freedom of participants. As the group has a (mainly) economic purpose, the question is, if it is really a social organisation and not just an economical corporation? The terms "mutual help and consensus", as the recommendation (s. p. 14) to use where possible natural social units as families, point more towards real social groups. The terms "mutual conditioning, control, norms, exclusion of non-participants, formal organisation" are pointing more towards institutions.

There are a several provisos against institutions, mainly based

[25]) ibid p. 30:

[26]) both quotes ibid p. 29:

[27]) ibid p. 345:

on their functionality: If they are not based on local needs, not "grown out" of a local understanding and local management precepts, they often turn out to be devoid of any functions, creating costs without returns. Even if the central governmental institutions can fulfill some basic functions as policy formulation and legislation, the lack of institutions with executive function, with real impact in the field, do annihilate all efforts at the central level: *"Finally, the institutions operating between those who make forest policy and those who plant trees are not working well. This critical lacunae in our knowledge of how to develop the institutional transmission gears between macro policy and micro farming has brought many promising projects to grief."* [28]) An experience fully conform with the case of Yemen (s. chapter 4.7)

The second critical aspect in the creation of institutions is the fact, that organisations set up aims, functionalise (automatise) processes and set up a total plan, not only for a specific enterprise, but for the whole society. Institutions can only be created for a specific purpose and for a limited time. Under changing environmental condition they have to change, to adapt themselves actively.

It might be preferable not to go for formal organisations, but rather for associations, freely formed groups of common interest. Those would have the advantage to be minimalistic in intervention - as there is anyhow no base for the social scientists dream of totally remodelling tribal societies that existed in almost the same form over thousands of years. The bare fact of such an old historical tradition demands a participatory, evolutionary and slow development: "*Denying on ethical grounds the legitimacy of engagement in policy formulation and program work has undercut rather than empowered the transforming influence of social science. As has been emphasized by many social scientists, given "the enormity of social illfare in modern times, ... it is morally indefensible to adopt a nonintervention stance when human suffering is all pervasive and when sociological technology has meliorative relevance.* [29]) "

The social scientist is surely better trained in "listening to the people" than the forestry engineer, but he still is (and has to be. s. chapter 3 on development) an outsider, a stranger to the society he intends to change. In traditional societies, probably in all societies, the causes and motives for change might be the technical/economical progress, wars, power - or changes of cognitive modes themselves. The impact of a foreign scientist is limited to the change of the cognitive mode - and even that is a social process, involving the whole group in a process of interactive learning!

If there is no group or no traditional system of environmental management, then the formation of a group looks bleak. It is the society itself, that has to create and develop the structures conceived as needed! The development and administration of such is an eminently political work - and with its long-term aspect in relation to forestry, most probably no business for short-

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[28]) ibid p. 305:

[29]) ibid fn 36:

term experts! The individual work with families e.g. needs very intensive extension work, an expanded extension service and is going to cause enormous costs! The establishment of women's groups as well is on one side promising, on the other side there are especially in the Islamic society certain problems, as the communication between males and females, the problem of moving around without a male relative, the reluctance and mistrust of the males towards women's groups.

1.2.1.2.2 Extension, Education & x-Disciplinarity

The traditional extension approach tries to improve the farmer's technical knowledge about the costs and benefits of tree growing. Knowledge on tested and proven tree planting, growing and tending practices and models is disseminated. Besides the fact, that societies are probably not a heap of clay, waiting for a sociologist to shape them into form, there is an other major obstacle. It is the traditional training of scientists in general and social scientists in special. Social sciences study what people in general do, what they do most of the time, what they have done up to now. What is needed for development projects, is to know, what they might do, what alternatives of procedures and organizations the might take up and under what conditions. What is needed is an understanding of socio-cultural development potentials, what asks for a shift from a deterministic to a probabilistic frame of reference. Cernea's experiences with multidisciplinary research groups look quite frustrating [30]): "*In still-not-uncommon pathological form, the multidisciplinary survey questionair has thirty or more pages, each discipline with its questions, which if asked are never coded, or if coded are never processed, or if processed and printed out never examined, or if examined never analysed and written up, or if analysed and written up never read, or if read never understood and remembered, or if understood and remembered - never actually used to change action. Large-scale multidisciplinary rural surveys must be one of the most inefficient industries in the world. Benchmark surveys are often criticised and yet these huge operations persist, often in the name of science of evaluation; they preempt scarce national research resources and generate mounds of data and papers, which are an embarrassment to all, until white ants or paper shredders clean things up."*
This just as an other authority, substantiating the reflections of chapter 2 "*Sciences*", 3 "*Development*" and 4 "*Orientational Knowledge*". Even the demand for a more open, heuristical approach has already been formulated here: *"Ironically, the most useful information from large questionair surveys often comes not from the survey itself but from informal observations by those who conduct it."* [31]) *"The problem of the academy's "over-reference for formal statistical methods", the inculcation of "inappropriate professional attitudes and rigidity in methods"*

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[30]) ibid p. 520:

[31]) ibid p. 521:

will be a rather long-term one [32]).
The problem with the adaptivity of the academic training to development research is two-pronged, as:

a) (social) sciences are not action oriented and

b) the natural and technical sciences, while serving as the model for science, don't care for the social aspects in their fields, even they do still treat social science with condescension.

The delimitation of what is scientific and what is not gets so dependent not only on universities, but on individual universities, disciplines, even professors. An experience that has not only been made (suffered rather) by the author, but as well by Cernea: "*A main source of the present difficulty with applied sociology is that attempts to make sociology relevant to policy are conceived and executed with disciplinary and not with policy concerns in mind."* And: *"The "significant other" for a social science scientist writing up his field "product" in a policy or project perspective is the policymaker or the development practitioner, while the significant others for the one writing within a disciplinary perspective are his academic peers."* [33])
While the need for change in social science education is in the direction of more operationality, b) the natural (and technical) sciences have to come done from the "throne of true (academic/-epistemological) science" and to include the social knowledge, because their "products" (s. def. "technique" in chapter 3) are having a heavy impact not only on the natural, but as well on the social environment. Unluckily the time needed to lead to this adaptation might be rather frustrating: *"The experts produced by this training ('technical') are deprived of a crucial lens - the social one - for looking at and understanding their own technical field. They are not being prepared to cooperate later with the social experts, don't know what to ask from them, and remain unaware of what they are entitled, as technical specialists, to receive from the social specialist. Correcting this situation is not a task for only a year or two, but rather will require a generation at least."* [34])

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[32]) ibid p. 522:

[33]) ibid p. 14:

[34]) ibid p. 35:

Development as Research Objective: : Pre-, Inter-, Trans- or Para-Disciplinarity?

The disciplinary research process leads to a fragmentary view. This is allready a problem in dealing with organisms (s. chapter 2.0.2). Much more complex it gets when sciences have to work together that are basically different, as natural sciences, social sciences and humanities in the search for an understanding of human dealing with the natural environment. In this case the coordination, cooperation and communication are getting (almost) impossible.

1 Definitions:

Interdisciplinary reintegration of knowledge produced under differing scientific perspectives is mostly been done by one of the following integrative strategies:
- problem, project
- guiding science
- person
But - Interdisciplinarity should be based on common thinking and not just try to fit different partial views together. That is what most often is done by interdisciplinary consultant teams, but it is "multidisciplinarity" and does not produce a wholistic view.
The transdisciplinary procedure, targeting hierarchical objectives through a hierarchy of disciplines, does not solve the problem of holistic cognition. The problems of coordination, communication and cooperation, being in fact translation problems, stay. Mostly they can only be solved through a person that has the capacity to shape the differing aspects and languages into a holistic view. A real interdisciplinarity is based on a true spiritual coherence, on a unity in topic and methodology, on a unity of scientific rationality.
Intradisciplinarity, where a consensus on research topics and problems is present, is a special case, where in fact only differing special fields are working together, not really different disciplines.
Often the unity of the concept can be reached by reestablishing the old disciplinarity, reviving old concepts of science. One does not always have to go back to the Greek [35]): *"The opposite to interdisciplinarity is not in all cases disciplinarity, but specialisation at any price."*
Let's have a look at Human Ecology. In the opinion of the author it would have to establish the base on how people deal with nature and how they would have to deal with nature. Indeed it studies in an action oriented manner the interactions between humans and environment. It sees itself as hermeneutical sociology, as exploratory, descriptive, heuristic and transdiciplinary synthetic science, reuniting natural and humanistic sciences. It wants to grasp the socio-cultural system in its ethical-normative aspects as well. In the definition [36]) the transdici-

[35]) Kocka p. 153:

[36]) Steiner & Nauser p. 214:

plinary aspects are clearly standing out: *"Human ecology is an holistic, integrative interpretation of these processes, products, orders and mediating factors that regulate natural and human ecosystems at all scales of the earth's surface and atmosphere. It implies a systematic framework for the analysis and comprehension of three logics and the interrelation between their constituents using a temporal perspective. These three logics are:*

1 A bio-logic, or the orders of biological organisms.

2 An eco-logic, or the order of inorganic constituents (e.g. water, air, soil and sun).

3 A human-logic, or the ordering of cultural, societal and individual human factors."

But - this definition makes as well immediately clear, why human ecology, in a society without the intellectual strata of scientists, makes little sense. In the archaic society the "WELTBILD" is still (more or less) intact and holistic. There is no bio- and eco-logic. There is a divine norm and a human logic. There is one reality that forms local thinking, acting and values, that shapes local rationality. The training of students, coming out out such a culture, in a multitude of special disciplines, is an unholy venture. The training of scientific specialists means the creation of a social strata, alien to the culture and society, predisposing integration problems. The learned scientific methods focus the strive for cognition on special scientific problems, that have no relation to the real problems of the society.

Our western culture did so far not solve the integration of differing disciplinary views - so why burden developing countries with such methods unfit to solve real problems? In addition there are the costs for such a multi-specialists-team. After Bormann/Kellert [37]) the following disciplines should be represented in an interdisciplinary team working on environmental management:

- geology / hydrology
- ecology
- planning / engineers sciences
- economy / politics / public administration / law
- sociology / social psychology / community work
- health
- ethics
- communication / information’s systems

That means we would need 16 experts! Assuming some multiple talents, as grouped in the table above, there are still 8 specialists needed, each one almost a genious [38])!: "*Each of these participants should be familiar with the language and fundamental concepts of the other disciplines represented, able to communicate his or her insights to nonspecialists, and experienced in multidisciplinary decision making. The team leader should be a capable environmental generalist as well as a trained and experienced facilitator.*"

The major problem of development, the reorientation of public

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[37]) Bormann, Kellert p. 123:

[38]) do p. 123:

perception by a fifth element, along with ecology, economics, ethics and aesthetics - education - is being touched here. But - Where are such people being trained nowadays? After Bormann/-Kellert surely not in the USA (in the Near-East neither): "*For the most part, environmental education at American universities does not prepare students for multidisciplinary teams and inter-disciplinary interactions.*"

1.2.1.2.3 The Main Problem of Policy - the Distribution of Benefits and Obligations

"Cernea argues that the profound behavioural changes to be elicited on a gigantic scale among farmers through social forestry are a shift from wood gathering to tree cultivation behaviour.")

"Concerned with how to provide effective incentives for smallholders to grow trees, the author's argument proceeds on three levels. First, at a general ***policy*** *level, policymakers must recognise the* ***pivotal role of small farms in both environmental preservation and in tree production****. National policies span a range of legal, financial, and institutional topics that set a macroscopic context that can encourage, as well as constrain, smallholder tree production. At present, few countries have policy frameworks designed to stimulate small farm tree production. Second,* ***development projects*** *must adapt their means -* ***allocations****. Guggenheim and Spears use a large body of field evidence to show how some projects still compete with and undermine local approaches to natural resource management. Third,* ***on the positive side, local level institutions governing land tenure, labour availability, production orientation, technical innovation, and access to capital must be brought into project planning through good social research and participatory project***

approaches." *...*[39])
Policy, incentives, participation and social research are seen as the main steering principles! Are they going to prove sufficient to induce that profound behavioural changes on "a gigantic scale"? Let's have a look at some precise aspects of policy recommendations in what concerns benefits [40]):

"1 Farmers often minimize their risks and maximise their benefits by growing trees which provide multiple outputs. Trees that provide fruit, fodder, and fuelwood, and enrich the soil are likely to be preferred to those used only for fuelwood, despite the higher net economic return obtained by concentrating on a single product.
2 Trees can diversify the farmers's sources of income, flexiblely providing income when other crops have failed during the dry season, or when household needs for income are greatest (for dowry, school fees, and so on).
3 Farmers are sometimes more interested in growing trees that require only small changes to existing systems, rather than the introduction of new and unfamiliar species and management practices.
4 Fast-growing tree species are the most acceptable to farmers who need to recover initial investment costs rapidly because of a high implicit discount rate.
5 Farmers will grow trees more readily if markets are assured, either through direct marketing agreements between large wood consumers (such as a pulpmill) or by obviously robust, lucrative, and expanding markets.

To make the major aim of social forestry possible, the creation and strengthening of social groups, two things are needed: an increased awareness for the need of aforestations and - motives, economic incentives, tangible benefits for the actors. The most promising and positive approaches in forest protection and management is, if those activities can be combined with job creation, e.g:
- employing villagers in planting trees ... and grasses ... on blank patches.
- spreading and phasing employment creation over the year to match the seasons of most severe underemployment in the area."

Further potential incentives are:
- The provision of **inputs such as seedlings, tools, nurseries** to decrease costs and increase production.
- Where *cash crop tree farming* is a viable option, provide **access to credit** to ease capital constraints during peak harvesting periods.
- The promotion of **secure land tenure or guaranteed usufruct rights** to alleviate equity and distributional problems and reduce risks, especially for the landless.
- To ensure fuelwood supply to villagers at a nominal, low price for the initial period.
- To supply smallwood, plough pieces and the like from outside

[39]) ibid. p 302:

[40]) ibid p. 321:

at cost prices, to meet villagers' domestic and productive needs.

- To offer a revenue-sharing arrangement under which the forest department would pay the villagers 25% of the selling price of the mature trees in cash ...

The major problem of incentives is that they will surely be weighed against the potential returns from free (fuel-) wood harvesting, and here the outcome looks bleak [41]): *" A study of agroforestry in Sub-Saharan Africa concluded that "as long as wood can be collected from common lands at a low cost by rural producers, there will be little economic incentive to plant trees on family farms to meet fuelwood demands." Supportive evidence for such conclusions comes from field investigations like those in Malawi, which found that the returns to labour invested in gathering fuelwood are fifteen times higher than the returns to labour invested in growing fuelwood and over five times higher than to labour invested in growing trees for poles. In light of such and other findings, the study on Sub-Saharan agroforestry pessimistically predicted that "agroforestry for fuelwood will not be widely adopted in Africa until the "free" wood resources of the commons have virtually disappeared.""*

If the main aim of a social forestry policy is to *involve large groups of people in the* ***conservation*** *and better management of existing forests and, since this alone would not be enough, to stimulate the widespread adoption of a "new" productive activity:* ***the systematic planting of trees for fuel****."* [42]) The specific aim of fuelwood plantation is too restrictive. That's e.g. where the FAO Forestry Project in Yemen started in 1985 - and failed. The continuation was institution building! For most rural societies, even those that are aware of the decreasing availability of fuelwood, "systematic planting" as an effort, an economic activity, can't be motivated by expectations of profit.
Policies should serve as guidelines for development. If policies are not or only badly adapted to the local conditions, they will only increase the problems. Adaptation can only be judged in local terms. What makes sense at one place, may proof destructive at an other. A possible solution e.g. for overuse would be a policy that restricts free access to forests. But even this proofed critical in certain cases [43]): *"Elaborate licensing procedures to obtain wood or other forest products encourage both illegal harvesting and mutual distrust between local populations and forest management agencies. In some parts of Latin America, anachronistic and environmentally blind regulations grant a property title to those who clear the land, with the*

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[41]) ibid p 374:

[42]) ibid p 344:

[43]) ibid (Guggenheim / Spears) p. 307:

predictable outcome of extensive tree removal." Not only for Yemen, but for the whole Islamic world, the same principle is fixed in the shari'a! But solutions are possible, not only by ignoring the shari'a and overriding its recommendations by power, but by legal interpretation (see fetwa Zabara in chapter 4.6.3.2).
Often the problems causing disappearance of woodlands are unrealistic and so unpromising expectations. SF itself collected more examples of problems than of solutions, as this one, being quite close to expectation in Yemen: *"Refusal to participate in afforestation with the reason: "the government of an Islamic country should provide for its citizens. A third large farmer, who wanted his fifty-six acres planted, asked for government-paid guards to protect the plantation and to restrict the access and customary rights of smaller farmers to collect grass and tree branches.*" [44])" Or [45]): *"Often forestry departments were asked to fully set up the village woodlots and then to hand them over to the village committee."* [46]) Or: *"The absence of a* ***contract*** *with the project or the Forest Department left a huge loophole that enabled the large landowners to avoid making contributions.*"[47])
The "absence of contracts" is only the tip of the iceberg. It is the proof for the fact, that rich people have the possibility to make money while avoiding to pay for "external" costs. Who might force them to sign a contract - and to keep to it? We see that social forestry has really to get involved into the local politics, into local planning and decision making. Social forestry can't rely on "technical recommendations", not even if the term "technical" is enlarged for the socio-technical, towards social engineering.

Social Forestry IS POLITICS!

So the Recommendation: Social forestry approaches have not only to put more emphasis on the socio-economic process - but on the steering of those! The emphasis on the creation of social groups should probably be refocused on the self-steering of social processes. Forest use, sustainable or destructive, is an ongoing process, done by individuals, villages (well organised or not) and the state. If management methods and groups taking responsibility for sustainable use have not been established in the past, there is a need for change. The intentional change in the direction of a process is called steering (cybernetics, see chapter 2.2.3) - and that's what the here presented approach is based on. As the development process should be determined by all participants, steering is a democratic, participatory process of thinking, planning, acting and learning, following Chamber's *"Physical and Human Paradigms for Development"*:

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[44]) ibid p. 355:

[45]) West Africa - Bois de village:

[46]) ibid p. 365:

[47]) ibid p. 355:

[48])

Aspect	*Physical*	*Human*
Point of departure	*Things*	*People*
Mode	*Blueprint*	*Learning process*
Goals	*Predetermined*	*Evolutionary*
Analytical assumptions	*Reductionist*	*Holistic*
Keyword	*Planning*	*Participatory planning*
Locus of decision-making	*Centralised*	*Decentralized*
Relation with clients	*Controlling, inducing*	*Enabling, empowering*
Methods	*Standardized and universally applicable*	*Diverse and locally evolved and adapted*
Technology for clients	*A fixed package of options (table d'hôte)*	*A varied basket of options (à la carte)*
Project output	*Infrastructure*	*Competence and choice*

1.2.2 Social Forestry Research Method and the "Bura' Research Model."

The emergency of the problem, the need for rapid approaches in understanding and action are enhanced by the rapidly increasing population and the connected progressing environmental destruction. As in the medical field, the emphasis is here on curing the patient and not on knowing all the details about his sickness - while he might die in the meantime. The problem of eliminating, or at least controlling, the cultural bias (ethnocentrism & semantic accent) is one basic problem of this study. Triangulation should not be misinterpreted as a "certistic approach", what would be epistemologically rather inacceptable since Popper's 'falsificationism', but can be looked at rather from the angle of hermeneutical 'understanding'. This understanding of complex systems has to go parallel with participatory

[48]) ibid. Chambers. Table 14.1., p. 532:

action and learning.
SF research methodology is based on five principles (s. chapter 2.3 on Ethnography, hermeneutics, communicatory truth):

1 Optimize tradeoffs / optimal ignorance: knowing when enough is known.
2 Offsetting biases.
3 Triangulation.
4 Learning directly from and with rural people.
5 Learning rapidly and progressively in an interactive, participatory way.

1.2.2.1 The Catalogue of Methods:

- secondary data review
- direct observation
- do-it-yourself
- key indicators
- seasonal calendar

- Questionnaires
- key informants
- semi-structured interviews
- group interviews
- chain of interviews

- historical profile
- ethnohistories
- stories, portraits, and case studies

- transsects and group walks
- mapping and aerial photographs
- diagrams (flowcharts e.g.)

- ranking, stratifying, and quantification (preference rankings / wealth rankings / direct matrix rankings)

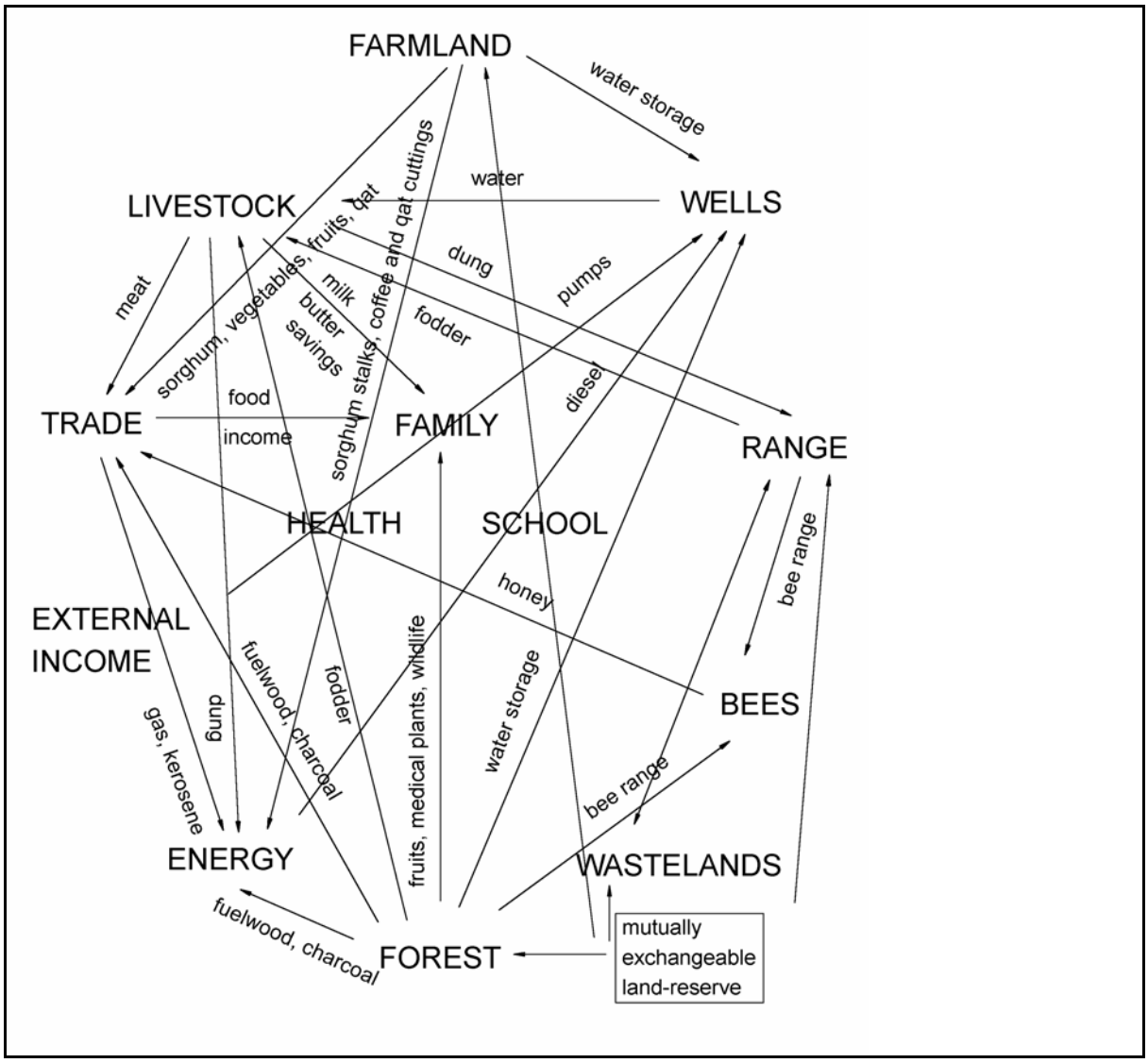
- views and arguments [understand and describe the local world of thinking and acting (*Weltbild*)]. The main points to be retained in the protocols where:
  1 Participants: active (or even dominant) and observants.
  2 Discussed topics, opinions, arguments and counterarguments.
  3 Strategies used in the discussion.
  4 Results of discussion, who is setting the final point (social class).

The RRA-methodology had to be a bit adapted to the specific conditions in Yemen. The basic principle was 'participatory observation' and interviews. The recommended and largely used method of '*just hanging around*' (Geertz; Harraz) is much more acceptable for the locals, if combined with some proper own work, as even in Yemen, that looks like a permanent-freetime society there is a time for work and a time for rest. So we used the 'time for work' to do our inventories and field studies, and the 'time for rest', chewing *qat* with the locals, to gather social data and information through different forms of semi-

structured, informal interviews.
As it is known form ethnographer's experience, the process of dialogue might be disturbed or even interrupted, if there is too much scribbling going on. So normally the results were written down immediately after the sessions, and discussed with the counterpart (brainstorming and de-briefing). In certain cases where suddenly loads of (historical) information came forward, the group was asked if they would agree to have those informations written down for further use, what was generally accepted with pleasure.

1.2.2.2 Structures and Functions to be Observed at Bura' *(Informal Questionnaire):*

The graph below shows the main structures and flows of the system. The aim of the research was to improve the knowledge, to understand the interrelations between those elements, especially the situation and importance of trees and forests, including trees on farm, range and wastelands.



The informal questionnaire used for the interviews (mainly group discussions) was:

- villages:
    - tribal affiliation
    - religious group: Saada, Shafii, ...
    - social classes: sayid, qadi, sheikh, aqil, farmer, merchant, butcher, servant.
    - infrastructure: gov. representation, health, schools
    - water supplies
    - The main problems of families and the village community
    - Is there any cooperative institution?
    - Which kind of work is done in family cooperation?
    - " " village "

family: members, occupations (s. as well external income)

farm: - size
    - crops: qat, coffee, fruit, vegetables, sorghum ...
    - farm owned or rented? / from private or awqaf?
    - livestock: number, use, prices

- Off-farm income through emigration to town (Hudeidah, Bajil), government post, awqaf, shop, labor or emigration to oil-rich countries.

- expenses:
    - daily staple food
    - additional food
    - trips to market, doctor, relatives ...
    - other expenses
    - accessories: car, radio, television, generator ...

- energy: consumption

- forest use (personal):
    - bees
    - medical
    - other: vegetables, fruit, spices, perfumes ...

- Are you interested to plant trees:
    - around the house?
    - on the farm?
    - other

- Is there a need for maintenance of the forest and range?

- Is there any protective system for range or forest as **Mahjour**?

- Under what conditions could you imagine to plant trees?

Control questions:

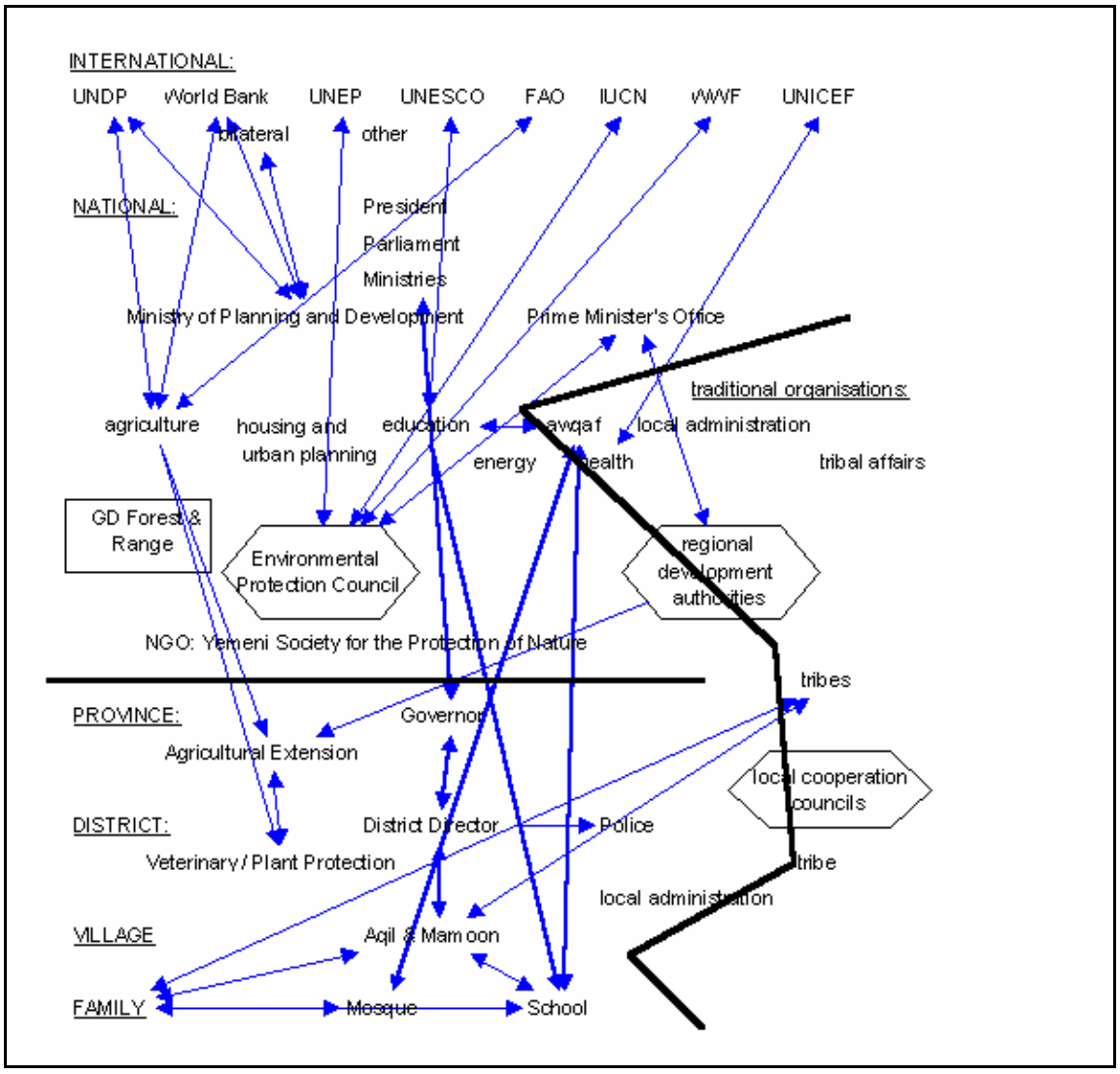
- Actions undertaken to improve forest and range?
- Trees planted?

As the aim was primarily to find ways of improving the use of trees and forests, that means of changing the destructive use, that means to find ways for steering, the study tackled different fields with increasing complexity:

- objects, things: crops, animals, plants, trees ...
- structures: arrangements of components in time and space
- processes: interactions of components
- steering: guidance and orientation of free, willful human action.

The graph below shows the hierarchical structures and the potential channels of "steering" that are available in Yemen.

Most international agencies have a very limited range of action. Instead of dealing with the real problems and the effective users of their recommendations and projects, their main efforts get stuck on the institutional national (in cases provincial and district) level. Forestry e.g does not have any executive institutions at a level below the national one. For extension the agricultural service is used - but this service rarely reaches the villages and the families, with a few exceptions as e.g. the very active veterinary at Jebel Bura'.



There are only two "channels" that really reach from the central government down to the villages and families:
> Government - Governors - District Directors - Aquils & Mamoons
> Awqaf/Ministry of Education - Schools
> Awqaf - Mosques
The regional development authorities, as the environmental protection, are under the direct control of the Prime Ministers Office. In spite of their name (probably because of the english translation) they put authority first and regional second. They have a very formal ("scientific") approach to problems and little relations with the villages and tribes. As most of the government they are not really "functional".
The world of a "normal" Yemeni is still ruled by traditional values and traditional organisations, as tribal affiliations and the larger family. The further away one moves from "government" towards village, the stronger the traditional relations and rules. Up to now there is no possibility to make any rules concerning forest (or in general environmental) protection known and accepted in the villages.
That was the main reason, why this research focused mainly on meaningful arguments (and information channels), arguments that are locally valuable and convincing.

1.3 The Pre-Knowledge on the System Available for Research Planning.

At the beginning of the here presented study, the only available systems oriented approach had been done by GTZ in the mid-eighties. Here the results:

1.3.1 The Functioning of the System (Resources and structures)

1 Land and water resources:
Water scarcity is the main restriction to development in Yemen! As the rainfall in the more arid areas is not sufficient to produce some crop, additional runoff water from adjacent areas is led onto the fields. Groundwater is already being strongly overused in all the country since quite some time!). Kopp [49]) said: *"A look at the natural geographical frame shows clearly, that South Arabia is not so much favoured as the literature indicates. The antique "Arabia Felix" as the impressive agricultural landscapes of the present are in large parts of the country achievements of a high culture that knew to use the natural geographic potential."* [50]): *"Refined technical measures result in a system of land use, that is perfectly adapted to the ecological conditions. Its establishment and maintenance asks as well for excellent ecological knowledge as of a highly organised community."* While the first part is perfectly right, Kopp is a bit too enthousiastic in what concerns communal organisation. This one is all over the country real basic.

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[49]) Kopp p. 56:

[50]) ibid p. 107:

The large scale terracing of Yemen is not the result of large enterprises but a cumulative effect of millions of farmers establishing their own terraces with the help of the family, friends and, if money is available, with paid temporary labour. After Kopp's studies slopes up to 50 degrees inclination (! not % !) are terraced. The surrounding walls are normally between 20 and 40 cm high. In flatter areas as e.g. the Tihama, with larger basins, they are up to 1m high, in steeper areas up to several meters. Kopp [51]) estimates that at least 95% of the agricultural fields are laid out horizontally and surrounded by a wall. The step-height between terraces is less than half a metre on 60% of all terraces, half to one meter on 30% and only in 10% of the cases more than 1m - what still is an area of about 170,000 ha!

The interrelation between agricultural land and runoff sets a strong limit to agricultural expansion in Yemen. The relation is fixed, the drier the area the more runoff-land (*sawagi*) is needed. The potential land reserves are so much less than it looks like and than is mentioned in different articles. Kopp says [52]) that "*in the total mountainous area of Yemen - some edaphic exceptions excluded - there is scarcely a square metre left that is not used agriculturally, respectively as runoff area...*" Moreover the runoff areas supply erosion material as a fertilizer. Only with this effect the "eternal" sorgho cultivation was possible.

The *Qanat*, a traditional system of groundwater tapping and transporting, has been abandoned since long, due to the fast increase of pumps. The situation of groundwater use and the lack of regulations is critical since over 10 years [53]): *"It is for sure that the first intervention into traditional water rights will be needed in the field of ground water use to stop overuse. The rapid extension of pumping capacity has already now risky effects in many parts of the country."* ***"Yemen is an example, that a LDC can take the maximum use of its own natural resources. Development in the far common sense leads to long term damages, that might be higher than the short term profits."***

The most important rule for the tribal lands is the "*guwarah*", the fact that the ownership of the land has to stay with the tribe. Land can't be sold to outsiders. This rule is only infringed by the Saada (Holy people, descendents of the Prophet). It should help to guarantee the political independence of the tribes, that depends itself strongly on the economical (mainly food = subsistence!) self-sufficiency. This rule does in fact enhance the findings of chapter 2.5.2.4, that the Yemeni economy is far from a market economy. That land can only be used, but not traded, is in fact an other facet of the anti-capitalist features of Yemen's tribal society. Kopp even claims that the experience over generations has shown that survival is only

[51]) Kopp p. 109:

[52]) Kopp p. 110:

[53]) Kopp p. 129 & p. 260:

possible with this type of economy. From outside markets only clothes, tools, appliances for the household, tea and weapons have been imported. Such conditions are only possible in a country locked out of the world market, as it was the case for Yemen until the revolution. The pride of the independent, free Yemeni farmer was to avoid contacts with the market, with the town. He never wanted to "serve", but to earn his and his family's living independently [54]): *"It shows very clearly that in terms of value little more than 10% of all agricultural products reach the market. In spite of the fact that the basic foodstuff (cereals, pulses) amount to 53.9% of the production value ..., the trade with them produces only 14% of the profits. Expressively profitable market products are coffee, qat, vegetables and fruits. (42.5% to 80.1%)".*
As long as the land could support the population, this system worked rather well [55]): "***Before the revolution the land has produced about as much as was needed for the local requirements, what is confirmed by all earlier travel reports."***

2 Population:
An other proof for the dominant influence of rain and water on "development" is the population distribution: The higher the rainfall the higher the population density and the lower the average agricultural area that is available per person (s. Taiz-Ibb).

3 Emigration:
It is the main factor for labour availability and costs! At certain times there is a lack of human resources, at almost any time the labor-costs are very high.

[4 Utilisation (s. chapter 4.4)]

5 Pattern:
Agricultural activity depends mainly on the amount of rainfall and on the rainfall patterns, on the seasonal cycles. Agriculture, range and forest are strongly interdependent and the influence of rainfall on farm activities is multi-factorial! Range, forests and wastelands are primarily seen as reserve for farmland. Fodder for the animals is harvested on all those areas, but the bulk from the farmland (leftovers, stalks). The strong dependency of the farmers survival on rainfall influences his view of trees and forests as well. If the rains are good, food and fodder grow well - and so do the trees - and none of that is due to human influence but all is due to Allah's grace!

6 Inputs:
The main inputs into small scale Yemeni agriculture are seeds

[54]) Kopp p. 172:

[55]) after Kopp p. 166:

and some urea. Only "rich" farmers own machines or pumps, and only large landowners employ workers.
The main tools after Kopp are the wooden (hooked) plow (*hali*), the planning board (*maharr, masabb, makam*), the dented sickle (*sarim*), a hoe and a seeding plough. To harvest seeds for the following season, the best ear is selected. Over the centuries the varieties got adapted to the ecological conditions.
Yemeni agriculture in general needs an extremely high labour input. The work process is as follows [56]):
- Durah 15cm high has to be thinned and weeded.
- When it is knee-high it is thinned again, 3-6 stalks stay together.
- Hoeing after each rain.
- When the ears start ripening, the leaves that are still green are harvested from bottom up and fed to the animals.

Where agriculture is done for market production, irrigation is dominant on the input side. The strong increase of pumps is a pressing future problem. The erection of dams on the other side might help to enrich aquifers, but is quite often more based on prestige thinking than on a proper economical evaluation. Already for Kopp the famous Maarib dam was an example for that. He mentions that, while 10.5 Million Rial have been spent for the preparation of that project only, for terrace conservation on the other hand only some 8 million Rial have been budgeted! The roughly 100 million US$ that were paid by Abu Dhabi have been spent before the secondary irrigation system was finished! Rumours were going around that time (1990) that another time the same amount will be put into the project. The rumours in 1993/94 were about an other dam, much higher and bigger, replacing the "old" one.
The inefficiency of such projects is uncontested. The new dam allows flood irrigation for 2000 ha with secure harvest, 1900 ha with insecure harvest and 1000 ha with pump irrigation. The area irrigated with the antique system was already 1100 ha! The costs for those 5000 ha irrigated land make - without costs for pumps!: 200 mio / 5000 ha = 40,000 $/ha - most probably never recoverable.
The problems with dams in Yemen in general are:
- The loss of *ghayl* irrigation land.
- High water losses through evaporation: 2 - 2.5 m^3/year!
- The spreading of malaria and bilharzia ... has already happened at Maarib!
- Silting up and loss of fertilizer.
- Culturally new types of irrigation are causing problems with the use of common groundwater by pumps and with the establishment of the secondary and tertiary irrigation system at Maarib - as everybody wants water but nobody wants an irrigation channel on his land!

8 Protection-Service Aspects:

Kopp was probably the first to raise the awareness to the point

[56]) Kopp p. 120:

that "*with all discussions on irrigation systems the* ***ecological systems interaction*** *should not be overlooked. The traditional yemeni irrigation methods achieved always an important contribution to the stabilisation of this labile ecosystem (watershed, soil erosion, nutrients economy and so on).* [57]) As an outstanding example Kopp describes the strip farming in the Tihama, a system that has unluckily almost been lost in the meantime [58]): *"They (*the walls. the author*) can´t be explained by the ploughing technique, as quite often cultivation is done here by hoeing. Much more they are the result of wind protection measures. Some walls stand orthogonally to the direction of the dominating western winds, overgrown with grass and shrubs. Often they go on and on for kilometres over all rugged terrain, and just in very large distances a transverse wall occurs.*"
In many parts (e.g. east of Sana'a, as well as on Jebel Bura' and Jebel Reima), evaporation is not only controlled by pruning of plants, the erection of stone walls or the plantation of windshelters, but the soil is covered with gravel, serving as evaporation controlling mulch.

1.3.2 Systems Dynamics

- Rate of growth: All over the Yemen the woody resources are shrinking at a very fast rate!
- Agroforestry Systems are rapidly degrading, as they are not real "systems". Nobody is taking care for their regeneration. Hardy and weedy species as mainly *Ziziphus* (luckily a very valuable plant in what concerns wood, fodder and fruits) replaces 'softer' species as *Dobera*!
- Historical background: The studies areas around Bura', as most parts of Tihama, have only been cultivated after the revolution of 1962-68 - and in connection with the introduction of pumps! Woodlands have been widespread before and the awareness on the scarcity of these resources is very limited.
- "Improvement" [investment]: Yemen is to a high degree dependent on money sent home by emigrants. The return of more than half a million emigrees after the gulf war led to the destruction of large areas of woodland, as most money was not invested in industries, but in farming.
- Sustainability: The agricultural productivity reached most possibly its maximum. Sorghum is the best adapted, most productive plant for the harsh semiarid environment of Yemen. A further productivity increase through pump irrigation will only fasten the depletion of the (often fossile) groundwater resources.
  The neglection of terraces leads in the same time to erosion. Unluckily the stabilisation through tree plantation has been found to be of no interest to the local farmers (s. Harraz Project).
- The outstanding feature of Yemen is its poverty! The lack of

[57]) Kopp p. 114:

[58]) Kopp p. 192:

functional institutions on most levels, the lack of reliable data and registers (population, land tenure, land use, e.g.).

1.3.3 Kopp's Evaluation of the System - in Respect to Trees

The evaluation at earliest stages of forestry work in Yemen show, that the Yemenis just don't give a dime on trees and forests". There is an urgent need for change in direction of that development. This holds not only true for forest trees but as well for fruits [59]): *Almost any permanent cultures are in a miserable state of neglection (except Qat and wine). Even the most simple cultivation measures as hoeing or the cutting of dead branches are left undone. The propagation is done in the most primitive way without any grafting; in the gardens the undergrowth (vegetables, cereals, alfalfa) has almost in any case the preference." "The astounding* ***discrepancy in the input*** *for the two principal cultures can probably only be explained as follows. Objectively the yemeni farmer has to produce basic foodstuff as bread grains and animal fodder, on his extraordinarily limited area with absolute priority. Permanent cultures are looked at a priori as luxury, what can be seen in manifold ways in the ownership forms of such gardens (Chapter III.E.). Under this premises he does not put subjectively high demands, neither on the productivity nor on the quality of fruits, especially as since centuries there has been little change in this matter."*

Contradictory are the following two parts, where Kopp was probably a bit too optimistic, almost euphoric [60]): *"Among the less noticed but manifold in the farms integrated uses goes the plantation of trees. Besides the mentioned species of fruit trees were the production of fruits is in the center of interest, in most parts of the country numerous species of indigenous woody plants are planted for other purposes:*

1. *In a country nowadays very poor in wood, the wood production is ranking high. Wherever possible the yemeni farmer plants trees on agriculturally not used plots to produce construction and fuelwood. In the east there are even special plots with priority for the growing of trees. Moreover different Euphorbias are planted that after drying serve as fuel.*
2. *At many places the fodder produced on agricultural fields is insufficient. The strong pollarding of trees is a common tradition. The many different Acacia species are suitable for that on all altitudes, as well the Tamarix species of the Highland.*
   So in the valley of Gawbah south of Ma'rib, where Ziziphus is planted (Steffen/Geiser/Dubach 1977, 46). In the Jauf the very best wood for the well known yemeni falling-boltlocks is produced."

Here Kopp is not objective, but ideologising. Nobody in Yemen is planting Euphorbias. They are a weed, indicating overgrasing.

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[59]) Kopp p. 121:

[60]) Kopp p. 101:

Wood production is not rating very high. Just the opposite is the case. Unluckily trees are of rather low priority, what is understandable if we look at the difficult living conditions, the all-dominating water problem and the other priorities:

Water - Hospitals - Roads - Schools - Service - Electricity

"Forestry" ranks somewhere on place 10 to 15. Only on Socotra forests have been put on rank 7!
Moreover Kopp's research, while delivering a rich foundation of knowledge, totally neglects the steering needs and potentials. Those have been emphasised in the following "Bura' Research Model":

1.4 The Bura' Research Model: STATES - PROCESSES - STEERING

The situation in Yemen is not comparable with the situation of a developed country, be it Europe or America. Yemen' society is tribal and not a differentiated society with specialised administrations.
The research aim is to detect:
- What forests and trees are "managed" (taken care of)?
- What is the potential (acceptance) for plantations?
- How did and do plantations develop?
- How do the formal and informal political and administrative networks look like, how do they work, how can they be improved? (= What are the channels for traditional top-down steering? How can new norms be introduced or unadapted old ones reinterpreted and replaced?)

The Bura' Model had mainly two functions:
a) to find out what is the importance of wood / forest for the local farmer - based on the fact, that he is not aware on it.
b) to detect the most promising steering factors that might enable us to save Jebel Bura's forest, and at which point of the system they can exert there influence.
The major problem here is, that "power", in a society where every individual strives for independence (and/or power), the effective use of power for steering is very limited.

While farming-systems-research and agroforestry concentrate on systems levels 1 to 3, social forestry goes into levels 4 and 5 - while still lacking a proper approach on the political level. The upper part of the table (1-3) represents the realm of cause-effect, stimulus-reaction, research, the lower part (4-6) the realm of meaning, planning and action - so of steering.

SYSTEMS, SYSTEM LEVELS AND STEERING PRINCIPLES:

integrative levels:	main levels:	factors / main steering principles	types of systems / models
NATURE	1 physical	**water**	structural-
	2 biological	**water**	functional
SOCIO-ECONOMIC	3 rural economy (agriculture)	**survival profit**	functional
CULTURAL	4 social (tribe)	**meaning**	structural
POLITICAL ECONOMICAL	5 organisational (state-business)	**aims**	prospective-operative
	6 legislative	**ethics**	normative

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