Forest Management, Property Rights and Information Systems

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Abstract

When a developing country is considering the various property rights options available for managing its forests, currently part of the public domain, what is at stake? In this article I argue that foremost is necessary to think at the forest as a natural resource where many different interests compete, and for which different tenure arrangements serve different interests; but where the impact of technology developments in these arrangements cannot be ignored. Finally I also argue that modern natural resource management must be case-information-based, and use information systems that can benefit from accumulated knowledge and experience.

1. Forests as a public good:

There may exist many convincing reasons - or special interests - behind the move towards changing the current public domain status. Yet, there are also good reasons - and public interests - to keep it as a public domain property. It is only fair to begin by pointing forest characteristics that make them in general a valuable public good (although it does not follow necessarily that public ownership is the best way to preserve a public good).

Forests protect soil fertility, by reducing erosion, regulating water supply, retarding salination, reducing silting and flooding; they are one of the most important factors in preserving ground water supplies; they provide indispensable habitat for many species; and they act as a "filter" for air and soil pollution. Because they impact on macro ecological processes that affect global climate, like the water cycle and the balance of atmospheric gases (converting CO2, for instance, regulating the greenhouse effect), forests can not be seen simply as a local resource, affecting only local or even national interests. Such global interests are an increasingly important factor when considering full tenure arrangements, in a world of globalized economy and policy interdependence, where international institutions and agreements are

gaining considerable weight (both as a source of policy and of enforcement).

The best known example of the presence felt by the interests of the international community is the rain forest, particularly in Amazonia; besides being an ecological micro-cosmos, it is also a showcase for the multiple and contradictory interests present in a forest. When local amazonian natives claim their right to exclude farmers that clear chunks of forest for agriculture, the farmers deny their tenure rights of exclusion, more often then not with the support or complacency of the local or even national government. When the international community want to regulate and curb deforestation, what is being put in question is the (Brazilian) national rights of full, absolute tenure regarding rain forest. This serves to emphasize that there is no "natural" and eternal forest tenure arrangements recognized by everyone, nor "natural" spatial or social boundaries in forest property rights; and since property rights depend on the recognition of a relationship among people where everyone concedes (or is forced to concede) a right to someone (person or group) [Ostrom 92], tenure arrangements are likely to evolve and change as people and conditions evolve and change. One good way of studying what various interests and tenure arrangements potentially exist in a forest, is consequently to follow the historical evolution of the relationship between society and its forests.

Despite this, forests share in general some common traits that influence tenure arrangements. They are in general broadly accessible, hardly excludable, with a clear set of natural boundaries that physically delimits this common resource (as opposed, for instance, with fish and wild life). They also have in general a subtractability property, that is, the nature of the resource is such that the level of exploitation by one user adversely affects the ability of another user to exploit the resource, even if users are willing to cooperate [Feeny 90]. To this subtractability property correspond subtractive activities, and listing subtractive activities is another good way of studying different interests - pushing towards different tenure schemes - that potentially exist in a forest.

2. Social and technological evolution changing forest interests and tenure:

The globalization of the economy is a relatively recent episode considering the long history of mankind. It would be therefore a mistake to assume that global, world level interests were relevant or even present in the forests, ever since the differentiation of human activities generated tenure conflicts [Dugatchevili 38].

Humans are part of the forest ecosystem. Although it is now common to find extreme views that separate the human species from nature in general and forest in particular ("Forest as a human resource" vs. "Protect forest by excluding human access"), at primitive technological levels, human impact was essential localized, and part of a balanced equation. For example, in Portugal, as in many other places, villagers used to pick dead wood and low branches from the forest for heat and cooking, as well as a few trees once in a while for home construction. While doing this, they were in fact keeping the forest less vulnerable to fire, and with a healthier renovation by avoiding overdensification - among other things.

Demographic explosion and unemployment, in a context of easier access to forest and technological improvements, increased the pressure towards more intensive and extensive forest use, or substitution of forest land with agriculture use, unbalancing the ecosystem (causing deforestation, for instance). It also brought conflicting uses of the forest. Examples of this can be found in Java, where unemployment drove many rurals to illegal cutting of Teak trees [Peluso 89], contributing to deforestation (Teak tree has a rotation of ~ 80 years; Pine tree ~ 20-30 years); or in Brazil, where miserable conditions led to mass migration to exploit amazonean forest, overcrowding the system and generating conflicts of use (farming and timber cut versus rubber tapping, for instance). Even for a skilled rubber tapper, it is hard to improve on the sustainability ratio of 1 person/ Km2 [Fearnside 89]. On the other hand, extensive clearing in forest rain compromise the habitat of many species that need a continuum, convex range of forest to survive.

New levels of exploitation of the forest brought with it new forms of class exploitation. For example in Brazil, Amazonia, rubber tappers became dependent of the "seringalistas" or "rubber barons", by virtue of the debt peonage system (aviamento), where the rubber tapper is too isolated to be able to place directly his product on the market, and to buy provisions [Fearnside 89]. Also, by the same reason, it is too costly for the government to build and maintain schools, hospitals, etc., so the social conditions deteriorate.

At the local level, the tradition was for the villagers to use the forest as a common resource, shared here and there by private ownership, but rarely with exclusion of access [Engels 85]. The current trend is for this open access to disappear, given the increased economic importance, types of use and conflicts of interest, which increase the appetite for exclusion and control. Variations in political context also play an important role. Examples of this can be found again in Java, and in Portugal. In Java,

by 1870, all forest not proved to be private owned became state owned, and open access ended. First the Europeans (change of property system to facilitate exploitation of Teak), then the Japanese (extensive timber cuts, transformation of forest land to agriculture use, to support the war effort), finally a centralist authoritarian government (control of forest use), reinforced this trend [Peluso 89]. In Portugal, with the democratic revolution of 1974, local power was born, but paradoxically this ended open access to forest. The new local elites appropriated the commons (baldios) as municipal property, and imposed fees and restrictions on access and use.

This "village economy" is often a host of forms of common property management. Runge theorizes that this local-level common property *should* emerge in such conditions [Runge 86]. In his view, relative poverty typical of such economy imposes a budget constraint on many forms of individual action to the extent that many activities are possible only through collective action. This is characteristic of economies of subsistence, where there is no margin for accumulation of capital, therefore for the high transactions costs of other forms of forest tenure arrangements other than joint use. Lawry adds that where the productivity of the resource is low and varies spatially and over time, individuals will require access to various portions of the commons season to season and year to year [Lawry 89], reinforcing the motivation for some form of common management. Finally, Runge points to the appeal of common property institutions in face of poverty and environmental uncertainty, to provide the right to be equally included as a hedge against uncertainty of spatial and seasonal scarcities.

New technologies, new industries (timber, paper, for instance) and easier access brought with them a national and regional level perspective of forest use. It also accelerated conflict of uses and forest depletion and degradation (1) and, with it, negative externalities, often at the origin of violent confrontations. National policies on forestry and forest tenure schemes emerged, and while enforceability remain hard and expensive, monitoring became easy and cheap, thanks to satellite and remote sensing technology.

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(1) I use the term *depletion* as meaning the reduction of a resource, in this case forest, to such a low level of abundance that its renewability is seriously endangered; and the term *degradation*, as a decline in the quality of the resource [Jessup 85].

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3. Forest uses and tenure arrangements:

While studying minor forest products in Indonesia, Tim Jessup and Nancy Peluso found interesting relationships between biological characteristics of the exploited species, rules of resource use and interactions among resource users [Jessup 85]. The so-called "minor" products are a vast array of non-timber products of forest, and in this case they include rattan (climbing palm), dammar (resin), and edible birds' nests (made by cave-dwelling swifts), bees-wax, rubber, fruits, etc. Among those products, birds' nests are the most valuable, per unit of weight; and also the ones with a peculiar pattern of high concentration and rapid renovation. How can this affect tenure arrangements? It is important to consider a characteristic of tropical forests, their large variety of species. Biologists know that when a number of species is high in a certain area, the number of individuals of each species tends to be low. The first implication is that most potentially interesting forest products are likely to be dispersed than concentrated, and so collectors must forage in a vast area in order to become economically viable. If on top of that some of the products are not easily regenerated, or take a long time to do so, this will make difficult any tenure arrangement based on the jointness of use of the resource, in consequence of the competition among collectors. On the other hand, a scattered distribution of a resource product will make them hard to privatize. By contrast, birds' nests are concentrated and occur within clear boundaries (a cave), and so it is more easy to adopt a private property regime.

In general, spatial distribution and regularity of a forest product has implications on tenure arrangements, particularly in relation with exclusion; it is clearly more difficult to monitor exclusion for a dispersed product than for a concentrated one.

Changes in forest use, or in levels of intensity of use (for instance, to increase production) also impact on tenure schemes. John Raintree points to the example of technological intensification of permanent farming as being at the source of gender and inter household conflicts, and landlessness [Raintree 87]. On the other hand, different tree crops may put in question traditional arrangements regarding long term vs. short term rights in land and tree tenure.

"Tree tenure" is a very interesting concept that in the least proves the power and creativity of spontaneous tenure schemes, that evolved through time, in contrast with the "social engineering" often proposed in top-down arrangements. At the base

of this concept is the recognition that tree tenure may be, at least in part, different from land tenure; that is, a tree may be owned by someone other than the land owner - for instance, the person that provided the seedling, or that planted the tree, or even that watered it! Fortman [Fortman 87] and Bruce [Bruce 85] refer to a case in Sudan, where the Islamic rules of inheritance resulted in a tree being co-owned by several dozen persons. On the other extreme, planting trees has been used (Africa) as a mean to secure land tenure, because of the connection between land and tree tenure. An interesting problem arises from this arrangement: it is necessary to monitor who is planting trees, or conversely find ways to prove planting the tree, in conditions that amount to trespassing.

Another reason for the tree tenure system, arises from the symbiosis of forestry with other land uses, such as herbaceous crops and livestock. Conversely, planting trees may be prohibitive of other more "serial" land uses. In either case, a farmer who grows trees needs exclusivity of tenure and security of tenure. Problems resulting of tenure insecurity are different for each type of dominant land use. Trees are long-term investments, therefore the period of exposure to risks posed by lack of security of tenure is increased; furthermore, the laws of inheritance become much more relevant than with short-term crops.

Louise Fortman summarizes the issue of tree tenure as consisting of a bundle of rights which may be held by different people at different times: the right to own or inherit, the right to plant, the right to use, and the right of disposal [Fortman 87]. This emphasizes that: one may own a tree, but not necessarily the land where the tree is planted (in this case, he or she retains the right to access the tree); one may have the right to gather, or harvest, tree products, but not necessarily own the tree (nor the land); one may have the right to destroy, lease, mortgage the tree, in separation of the land, or despite different land ownership. The "one" may refer to the state, groups, households or individuals.

4. Characterization of property regimes for forests:

Nowadays, it is assumed that there is a clear framework for either public or private ownership. In the first place, we saw already that even within these apparently well defined property regimes there is room for a web of complex tenure arrangements. In the second place, although it can be argued that public domain is a form of common property (involving a national population), public ownership is modernly

equated with state ownership, leaving behind many forms of property regime known as common property. Feeny, Berkes, McCay and others criticize the frequently found ambiguities and confusion that arise from the lack of clear definitions of these concepts. In their view, one thing is common-property resources, and other the property-rights regime in which the resource is held [Feeny 90]. Resources are "intrinsically" common-property types, if by their physical nature it is hard or impossible to control access (excludability), and their typical use is subtractive (the notion of subtractability was already discussed above). As for property rights, they define four categories found in common-property resources: open access, private property, communal property and state property. Feeny, Bromley, Ostrom and others admit that in practice these property regimes seldom come in their pure form, and more often in overlapping, sometimes conflicting combinations [Bromley 86] [Feeny 90] [Ostrom 92]. In "Open access", the use and exploitation of the resource is unregulated and is free and open to anyone. Under "Private property", an individual or entity has rights of exclusion over everyone else. "Communal property" is a form of property where the resource is held by some community of users, with rights of exclusion over outsiders. "State property", the rights to the resource are vested exclusively in a national government, which regulates use and access.

These definitions are by no means "standardized" within the research community. The interest in the subtleties regarding common property arose particularly after the famous Hardin's article "The tragedy of the Commons" was published in 1968 [Hardin 68]. Hardin's argument was basically that Bentham's goal of "the greatest good for the greatest number" is impossible, since maximizing population does not maximize goods; that prohibition is easy to legislate (although not necessarily to enforce), but "temperance" is not; and then proceeded to re-invent the prisoner's dilemma in its most common form, the "free-rider dilemma" [Poundstone 92] (a prisoner's dilemma with many, rather than just two players) applied to a pasture open to all, showing that the dynamic of "*freedom in a commons brings ruin to all*" [Hardin 86].

Garrett Hardin's article is undoubtedly an important contribution to the understanding of a very real and common problem. However, in my view the reasoning has several hidden assumptions that are not universal truths. Just like Vladimir Ilitch Oulianov pointed to Malthus that each born child doesn't come to this world with just an empty stomach, he or she is also born with two arms and a brain, I would point that, as surprising as it may be, there are many instances where

human beings and communities choose to adopt a behavior opposite to the "sacred" principle of maximizing one's profit, and succeed, against all "rational" expectations...of those that mistake an economic assumption for the human nature. Free-rider defection is one of the usual objections to the socialism of Thomas More's Utopia, and Karl Marx. The reasoning goes this way: If everyone worked hard and goods were shared intelligently, no one would starve or lack of basic necessities. At the same time, everyone would be tempted to loaf, knowing that they would still eat and that their personal "defection" could not hurt much the collective. If everyone did that, the commune would fail and people would starve.

Besides this criticism, a literature critical of Hardin's "tragedy of the commons" analysis has developed in the past fifteen years. Ciriacy-Wantrup, Bishop, Lawry and others argue that Hardin failed to distinguish between open access and common property [Lawry 89] [Wantrup, Bishop 75]. For Wantrup, Hardin's hypothetical pasture is a valid example of open access, and distinguishes between open access situations, characterized by an absence of property rights ("free-for-all"), and common property, where individuals had certain specified use rights to a common resource. Here "common property" is closer to what Feeny defines as "communal property".

In general, there is some consensus (not universal!) on the following considerations:

"Open access" cases seems to support Hardin's argument relative to degradation and depletion of the resource, although in some cases another factor shares the responsibility for such outcome: imposed open-access conditions over the destruction of existing communal land tenure systems, during colonization. Feeny cites a case in sub-Saharan Africa [Feeny 90].

Private property has the problem of usually costly enforcement of exclusion. The way the community feels about the legitimacy of the private property will affect these costs, just as the nature of the spatial distribution of the product, as referred above. This regime usually provides incentives for rational exploitation of the resource, but not necessarily consistent with sustainable use, particularly when external incentives are towards destructive use and quick returns.

Communal property has usually smaller costs of exclusion, since it is directed mainly at outsiders; the level of success is related to the strength of local institutions, and to the lack of external pressures (over the consumption of the resource, the

technology of exploitation, or political and economical context in general). There is abundant evidence on the ability of communities to create ingenious mechanisms to allocate use rights among members. Runge points that free-riding is implausible where common property institutions provide individual commons' users assurance about the behavior of others by making and enforcing the common property rules [Runge 86].

State property has usually the best conditions to provide for adequate exclusion (regulation of use), and high technological level of management of the resource, particularly if it implies large investments and over time. However, as the many examples above mentioned from Brazil, Indonesia, Portugal and others, it also is the regime in which the forests are more vulnerable to mismanagement and short-sighted politics, given the scale of their impact. Cases of successful management are not so common in developing countries.

An interesting hybrid arrangement is what is called by Lawry "co-management" [Lawry 89]. The state (government) assign group rights to a specific territory, provides technical guidance on resource management practices, and helps to create a more positive economic environment for cooperation. A local community organization distributes income among members, mobilizes community participation, and advises the government on the social and economic acceptability of proposed management practices and rules. Lawry view is that a co-management model can be helpful when dealing with the problem of enforcement. "*The government can assist in enforcement of rules which have broad support in the community, especially when community authority is not strong enough to curb free-riding*" [Lawry 89].

The main problem with this approach (assuming that there is no deep distrust towards government, and that government agents really value local input) is that it will require highly technically trained staff, if local communities are to see any advantage in this arrangement; and such staff is usually in short supply.

5. Case-based information systems for common property management:

Research on common resources management (CRM), a subset of the vast research domain on common property regimes, struggles with the lack of a structured library of relevant cases. The problem is compounded by a "syntactic" and by a "semantic" problem:

On one hand one needs more than written papers or reports to grasp the complexities and subtleties surrounding each case; for instance, dynamic visual data - typically recorded in videotapes, during series of field surveys - is often essential [Wiggins 90]. The sequential nature of the traditional analog video devices makes the search for the significant video segments a time consuming and tiring task, which further discourages the integration of that data in the analytical process.

On the other hand, case studies from various parts of the world provide conflicting evidence on the sustainability of forests under similar property regimes. No simple system can keep its consistency under these circumstances; for instance, it is not possible to use the already "traditional" approach of Truth Maintenance Systems in Database and Expert Systems.

Case study materials collected for other purposes can be useful for "*crude hypothesis testing*" [Feeny 92]. They may be used to generate hypothesis inductively, as suggested by Elinor Ostrom [Ostrom 92]; or they may be used to test hypothesis derived from theory or from previous inductive reasoning. Examples of case studies to test hypothesis are the studies to examine the effects of group size on the performance of institutions managing common-property resources. Bullock, Baden and Feeny mention similar use of case studies [Baden 77] [Feeny 92]. One advantage of this research approach is that it reveals patterns of variables or factors impacting on the outcome of the case. For instance, Feeny reports four factors that emerged from the referred study: cost of intragroup enforcement, cost of group exclusion, cost of decision making, and cost of coordination [Feeny 92].

An example of an information system designed to help policy makers to make the most of a case-based approach, could be a "multimedia data base of research cases". The system model I will introduce is intended to illustrate the potential the new "intelligent" multimedia technology has to help solving this problem.

The typical users of such a system would be primarily common resources managers and decision-makers, to better draw on other experiences when defining or changing rules and deciding on institutional strategies, and to facilitate collective access to the rationales of such decisions, assuming a participatory decision making process. However, the CRM research community could profit from it as well, to better understand the cause-effect relationships between rules of use and operation, the political and institutional context, and the degree of success or failure.

5.1. On the data structure:

The data unit of this multimedia data base would be the *common resource research case*. *Common resource* is defined here as any natural resource that is shared by a community of users under some form of common property regime. Examples of natural resources besides forests are water, land, fish, and wild life in general. Because in many cases the boundaries of such common resources are not clearly defined (or overlap), it is more convenient to establish as an independent data base unit each case of a common resource with an identity of its own that became the object of research.

The body of this data unit is structured the following way:

- Case identifier (usually a name). Serves as index key;
- Context (resource type, geographic location,etc.);
- Initial status (conditions at a date defined as the beginning of the research period);
- Actions (deliberate, controlled human intervention impacting on the resource and its users);
- Events (non-deliberate, non-controlled natural or social changes impacting on the resource and its users);
- Final status (conditions at a date defined as the end of the research period, if past, or the current date);
- Outcome (degree of success or failure, which may be user defined);
- Experts (persons contributing with information).

5.2. On the data model:

The popular aphorism "there is no such thing of a free lunch" is particularly valid in the world of data base design. In this case, the more structured the data is, the better we can manipulate it; but also the greater loss of information content happens in the process. In this system, I use a data model with two levels of abstraction (consequently, two levels of structure) to capture as much as possible the best of the two worlds; in this case, the trade-off is with redundancy. To illustrate this data model, consider Fig. 1:

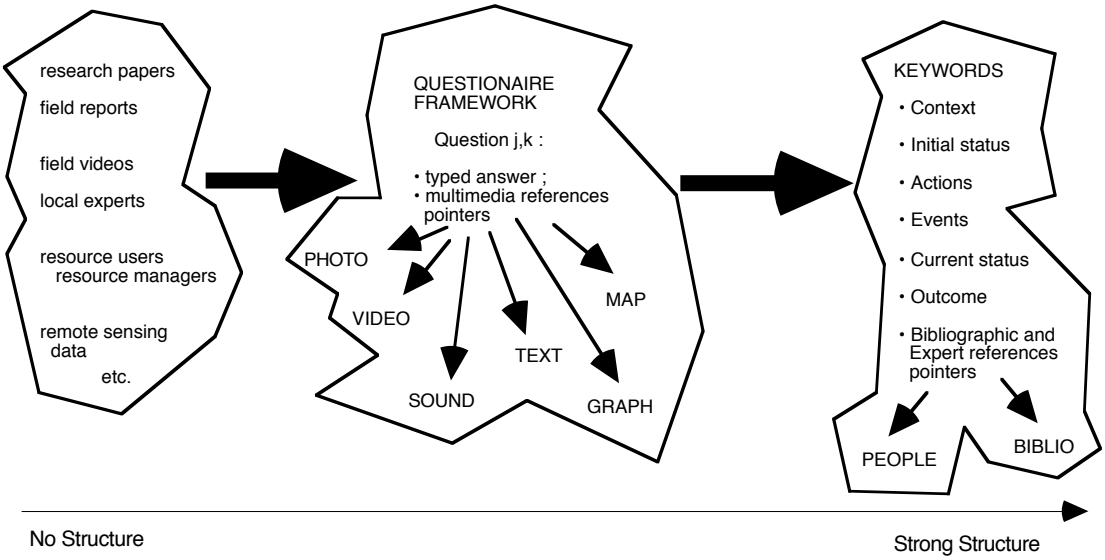

Fig. 1 Data model

Outside the data base, data is not constrained in any way by a particular data model structure. By bringing it in, through a pre-defined questionnaire, and then linking each answer with specific multimedia references (for instance, several discrete video segments), some structure is gained, which facilitates for instance comparative analysis between different cases. At the same time, some information that does not fit neatly in the questionnaire framework, will be lost. This is the first level of abstraction, which still allows a large degree of freedom, like free text directly typed into the data base, possible contradictory opinions and references, etc. The questionnaire adopted is Omar Razzaz's framework introduced during the course on "Common Property Resource Management", and is included in Appendix.

A second level of abstraction is then possible, by "summarizing" the characterization of the common resource case by sets of keywords. This allows for more sophisticated data analysis, such as cluster analysis, search by patterns of keywords [Pearce 92], and deductive or inductive inferencing by generalization from the "nearest" matches among the data base cases (case-based reasoning). The price to pay is a more imperfect representation of the case - semantic loss - together with some redundancy - keywords may in some cases be a simple repetition of some of the sentences of the questionnaire's answers.

By adopting an object-oriented representation, it will be possible to structure even

more this information with recourse to a hierarchy of classes and class instantiations. For instance, a class Forest has associated all the relevant information that is shared by any and all forests; when a forest case study is added to the system, it is sufficient to declare it as belonging to the forest class, in order to inherit automatically all that information. A taxonomy of forests can be represented under this class hierarchy (for instance tropical forests, sub tropical forests, etc., for forest class; rain forest, non-rain forest, for tropical forest subclass, etc.). The same taxonomy can be tentatively introduced for property regimes to profit from the inheritance mechanism, but it is harder to achieve given the lack of rigorous consensus over the definitions and concepts.

The handling of conflicting evidence is a challenge, but in this data model it is possible to adopt Lenat's approach of co-existence of multiple belief or truth systems within the data base. This approach implies the introduction of an operator to detect conflict, and to call upon meta-rules to handle each conflict type.

An example of such meta-rules would be: if two cases (A, B) present all the same keywords identifying status, actions and events, and one of the keywords identifying outcome is different (not matched), we have a conflict of evidence. Then, search for all other cases in data base containing the conflicting outcome keywords; select among the cases those that contain the larger match of similar keywords defining status, actions and events; list the non-matching keywords defining status, actions and events; suggest to the user that the reason for conflicting outcome may be found in the fact that one of the keywords in this list is in reality present in case A, despite the fact that case A representation was not given that keyword. This way, the system has the means to infer best possible matches in conditions of conflicting truth systems, and give useful hints on analytical efforts to "break" the conflicting evidence.

5.3 Example of the information system with a prototype:

Given my research interests in this domain, I have been recently developing a prototype of a system with some of the proposed characteristics. As a good product of the "hacker culture" generated at MIT, I can program faster than I can write; in consequence, while preparing notes regarding this proposed problem, I introduced some quick changes in the prototype to test some elements presented here (regarding keyword search and match). I will use therefore my proptotype as an approximated illustration of how such a system would look like.

This prototype is developed in Hypercard, with recourse to some external commands to complement Hypercard handling of color, menus, and of floating windows. Some of these external commands were programmed by me, others were acquired (windowscript) or extracted from public domain software.

Fig. 2 - Main system window

The systems consists of the main stack, "CRM research system", two specialized stacks - for bibliographical information ("hyperbiblio") and brief presentation of contributing experts ("people"), and several files of different types containing the multimedia references linked through pointers with the information contained in the main stack.

Fig. 3 Resource case descriptor window

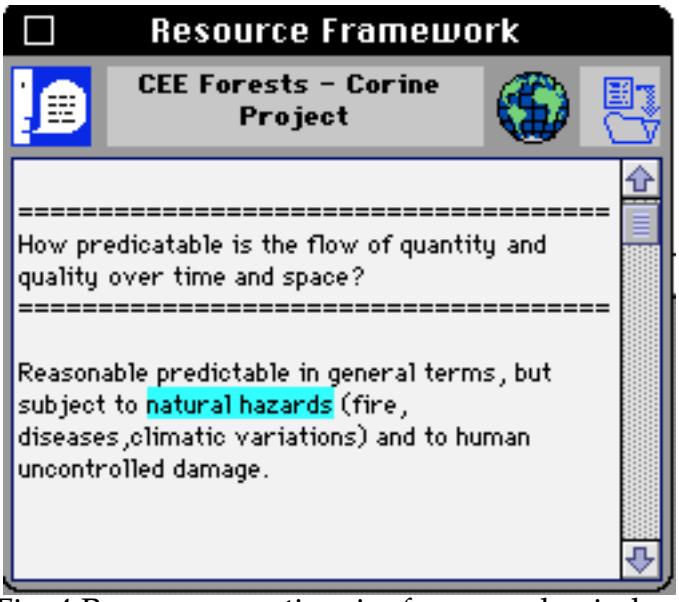

Fig. 4 Resource questionaire framework window

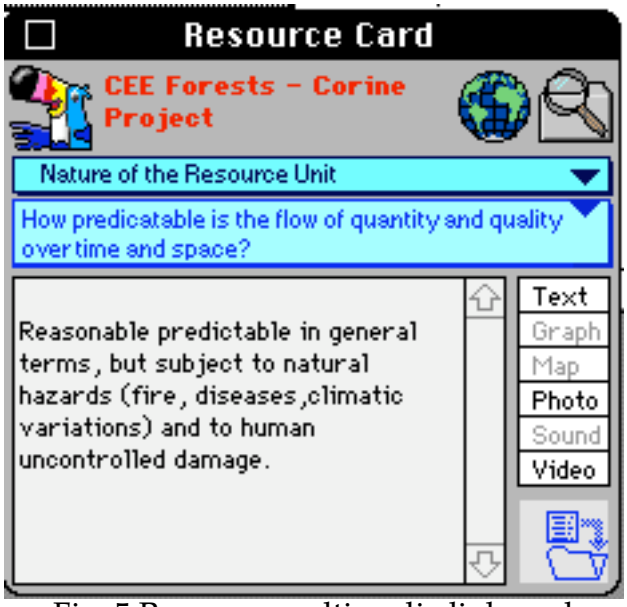

Fig. 5 Resource multimedia link card

Fig.2 shows the main stack index card; Fig. 3 shows the resource descriptor window that is called by clicking on a resource name (in index); Fig. 4 shows the window were the users can type answers to any of the pre-defined questions (which may be expanded); Fig. 5 shows one instantiation of the resource card for viewing and/or establishing multimedia reference links with each of the answers.

Fig. 6 and 7 illustrate the use of the "Resource Card" to browse through the multimedia references; in Fig. 7 the answer "multimedia descriptor" of pointers is visible, with its simple metadata structure (media type, media file, reference legend).

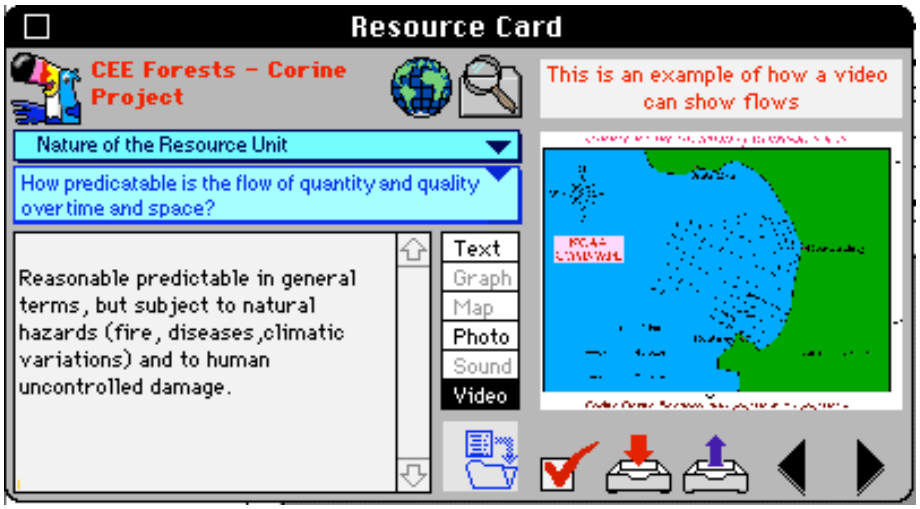

Fig. 6 Video references associated with selected question / answer is shown

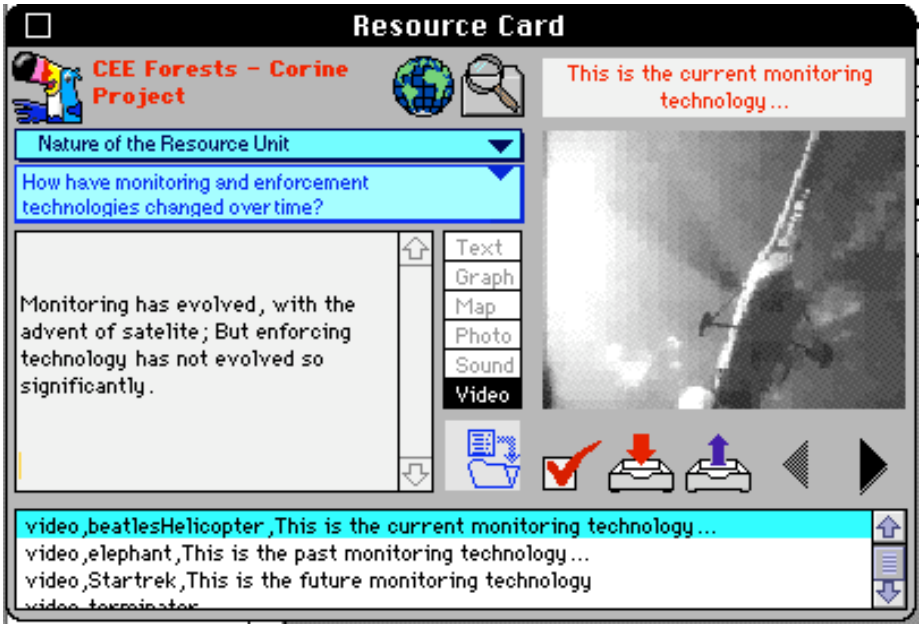

Fig. 7 Multimedia descriptor with pointers linked to the selected question / answer

Each case is geo-referenced to a large world grid, to allow for aggregated search by geographic zone. The world map grid navigator (shown in Fig. 8) has two-way links with the resource stack: one can find the general location of a resource case from the main resource stack, or, by clicking on a set of grids, identify all resource cases pertaining to the selected areas.

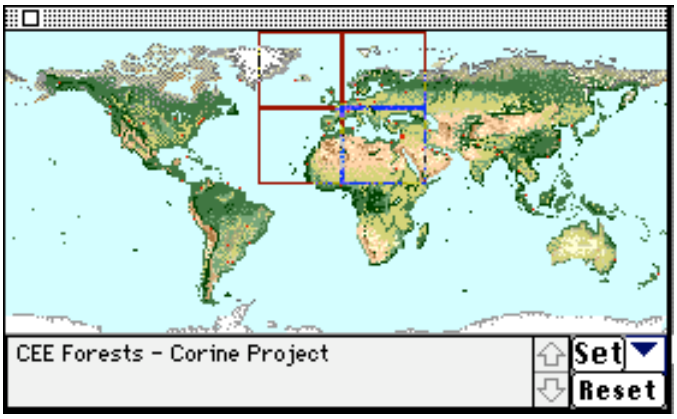

Fig. 8 World map grid navigator

Providing the user with some information about the people that inserted data into the system is important not only to facilitate further inquiry, but also by reasons of making people both credited and accountable for the information they contributed. Fig. 9 shows an example of the "Expert reference stack".

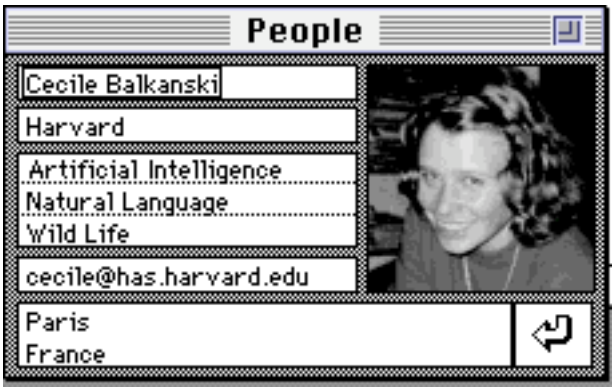

Fig. 9 Expert reference card ("people stack")

5.4. Conclusion on the prototype:

At this point, the developed features correspond mostly to common data-base operations, extended to handle multimedia links. This proved to be satisfactory. It remains to be seen if these features can be successfully be extended to allow for expert-system-alike operations, such as the above mentioned for case-based inferencing. It is my intention to test this assumption in future work.

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APENDIX

Questionnaire Framework for Common Resources Management, adopted from Omar Razzaz's notes

used for the multimedia data model

Nature of the Resource Unit

How predictable is the flow of quantity and quality over time and space?
Are there good indicators of resource units' present conditions?
What is the appropriation technology?
What is the monitoring and enforcement technology of quantity appropriated?
How have monitoring and enforcement technologies changed over time?

Nature of the Resource System

What is the size of the resource system?
How does the resource system overlap with political and social boundaries?
Are the resource system boundaries clear and known?
Are the resource system boundaries enforceable - to exclude outsiders?
What is the resource system boundaries enforcement technology?

Supply and Demand Conditions of the Resource

What are the market conditions for the resource units?
Do users display competitive - cooperative or monopolistic behavior?
Are the resource units used for subsistence - or local - regional - international trade?
What is the relative scarcity of the resource unit in relation to other substitutable resources?
What is the frequency and dependability of the yeld?
Is the yeld declining per unit invested?
Is it possible to increase the present yeld?

Characteristics of the Users of the Resource

What is the number of users?
How homogeneous are users in terms of income - culture - ethnicity - exposure to risk?
Do users share norms that influence their behavior vis a vis the resource?
How reliant are the users on the resource?
What organizations do they belong to - unions - tribes - religious?
What institutions and sources of authority exist among the users?

Legal and Political Context for Resource Users

What are the operational rules governing the resource?
What are the rules pertaining to exclusion?
What are the rules pertaining to regulation of use?
How is use of resource monitored?

What are the enforcement mechanisms?
Is coercion used to enforce rules?
What types of sanctions exist?
What are the conflict resolution mechanisms?
What is the collective decision making process?
How are rules and mechanisms modified?
Who makes decisions on rules and modifications?
How is the local system of rules related to external regulation systems - government?
Are the local rules an extension of external regulations?
Are local rules legitimized or undermined by external systems?

Successes and Failures of Resource Management

What is the chosen criteria of success?
Whas this Common Resource Management - CRM - case a success or a failure?
How have all described factors contributed to the failure or success of the CRM process?
Could the failure be averted?
Could the success be replicated elsewhere?