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Village People and Satellite Imagery

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WHAT'S THE MAIN IDEA?

Village people can understand and interpret information derived from remote sensing satellites on soil, water, drainage, land-use, forests, efc., when such information is presented in the form of large color-drawings or maps. Participatory Rural Appraisal (PRA) maps made by villagers are critical in enabling a clearer insight into village-level systems. Satellite-produced information has to be used with care because certain levels of detail will exclude village people.

HOW IS THE INFORMATION ORGANIZED?

The paper first deals with the jargon. Next, my confusion: how can both villagers and outsiders (us, well-meaning but ill-informed) come together to understand natural resource base issues which extend beyond a single village. This leads to trials, followed by findings and uses. Lessons learned are ultimately shared with some general recommendations.

DEFINITIONS

Participatory Rural Appraisal (PRA)

PRA is a set of methods for working with village people. It is also a state of mind about letting go - letting go of our biases, our expert opinions, our solutions. It is also about listening - listening to village people, listening to the users.

Satellite Imagery

A satellite is a ball of metal, plastics and wire, and is extremely heavy. It is taken by a rocket about 900 km. above the earth and left on its own. Instead of falling down, the satellite begins to circle the earth, passing from pole to pole - endlessly. This means that it passes over the same point over the earth every 15 days or 22 days, depending on the model. The satellite senses different levels of heat in wave lengths on the earth and relays this to a large tapedeck on the earth. The earth station has an awesome

collection of wonderful machines and wise, learned people, who are able to convert the heat wavelengths into information sets, e.g. types of land, water, forests, and land-use. This means that if your budget allows it, you can track changes in the natural resource base, in a designated project area, every month or every fortnight.

False Color Composites (FCC)

Some wavelengths are better at spotting subtypes in water, while others are better at subtypes in soil. Sometimes one combination of wavelengths (e.g. bands 2,3,& 4) is better for one subject than another combination (e.g. bands 1,4, & 3). These bands are assigned colors. They can be made visible on a color monitor or as a colored print. These colors do not usually coincide with the real colors on the ground. The color red usually represents green vegetation. Such colored prints of satellite relayed data are called false color composites or FCCs.

Geographic Information Systems (GIS)

GIS are a set of software that can merge and match graphics (pictures) with a data-base (numbers). FCC data and topo sheets can be digitized (converted into thousands of tiny dots) and fed into a computer. Statistics can be fed into a data-base program. The computer can then be asked a question like "Show me all the villages that are more than 3 km. distance from a primary school". A pretty picture will appear on the screen, showing a map of the area. While all the villages will be shown, those which are more that 3 km. away from a school will be in pink circles. Very alluring.

THE PROBLEM

Using PRA, we have had a series of analyses of rural problems with village people. These, for the most part, have had the village as the focus, and the land belonging to the village, as the system boundary. Sometimes this boundary has extended beyond the village to the immediate water-shed. PRA maps made by village people have served well in aiding discussions. However, a project area has many villages. Some resources like water, forest and common lands have users from many villages.

Assembling single-village maps into one larger area map did not seem feasible because of differences in orientation and size. Topical maps and models, e.g. afforestation on common lands, have provided alternative tools, but again a larger picture over large areas was not available.

THE TRIALS

Topographical Maps

Topographical (topo) maps of 1:50000 (1 cm.= 1/2 km.), have been used to focus discussion over larger areas. They are useful for infrastructure information but less so for natural resources. But to acquire a FCC, the topo is critical. It is on the topo that areas for the FCC are marked. These then are sent (in person preferably) to the remote sensing agency (NRSA), along with a choice of dates. NRSA locate the required scene from the tapedeck. If there were too many clouds in the first selection, they scan other dates of the same scene. The final selection is then sent off for processing the wavelengths requested. After a three week wait, a beautiful colored FCC is handed to us.

FCCs and Village People

This FCC (on a scale of 1:25000 (1 cm.= 1/4 km) was subsequently used for our field work. We reached one of the villages on this FCC and had a discussion with a group of ten village men.

The FCC was displayed with a simple explanation which went something like this, "At night there are stars in the sky. Sometimes, have you noticed that one star seems to be moving steadily? Well that is a satellite. And it can take pictures. This is one of the pictures. This picture may seem a little strange because all the red that

you see is actually green. And the green is not actually green..." We also traced the fair-weather road that crossed a stream bed (red spots), went between two hillocks (grey-blue), through a tank-bed (shades of grey), and by the side of a rocky hill (thankfully brown). Once orientation was established, the village people took-off on their own. Villages were identified by name along all roads, as were all tanks. Drainage networks were located. Soil types were identified. Some young men suggested digging trenches and channels on the rocky hill near their village to divert more water towards their village. However a village elder discouraged the idea. Since our goal was to check the extent to which village people could interpret a FCC, we closed the discussion, and moved on to another village.

FCCs and Project Area Edges

In the second village, we discovered after 30 minutes of poring over the FCC that the village we were sitting in and trying to analyze did not exist on the FCC. (This was due to an error in stating the co-ordinates when ordering the FCC). In the process, village people identified streams, tanks, and hills by name. Major all-weather roads were identified. Irrigated and non-irrigated areas were located, along with a regular array of red spots which was interpreted as a eucalyptus plantation.

Attempts to Reduce Expenses

The 1:25000 FCC costs around Indian Rs. 7000, while the 1:50000 costs Rs. 2000. (US$ 1 = Rs. 30 approximately). We figured that Rs. 2000 per FCC is cheaper and each shot would cover a larger area. So, armed with our favorite topo sheets, we placed orders for 1:50000 and acquired the FCCs. We found that the 1:50000 was useful from a project perspective in identifying major zones. It was not so useful at the village level discussions, as details were blurred. Broad areas could be identified but detailed discussion could not be done while following a stream course, or while discussing the possibilities around a specific hill.

The GIS Siren

GIS seemed to be the answer to all the problems related to monitoring. How nice, we thought, to have a visual picture of coverage for literacy and immunization and other things we want to measure. Month after month, at the press of a button, out would roll these wonderful colored proofs of our progress. Because these would be all visual, village people would be able to participate in the monitoring also. Real life turned out to be different. The GIS software is expensive. It also needs a wider array of peripherals (other machines like scanners, digitizers, special monitors, and plotters). The millions of dots involved in graphics require massive amounts of memory, both storage and processing. This means that a faster processor is also needed. Saving and retrieving times need to be faster. And investment in learning time is a must to be able to use all this hardware and software.

Instead of buying, we decided to hire computer time. We found that there were problems in relating topo sheets and FCCs with complete accuracy. Some fitted, some did not. While all this was going on, we also stopped to think of the implications. A rural community has many subsets. Each of these subsets are different. Some subsets have a strong access to the resource base while others have limited access. Levels of skills, knowledge and survival strategies differ. The amount of power to influence both the access to and the use of the resource base also differs.

A rural community is complex. The real power of a GIS is in aiding decision making. The computer is fed information which can then produce model solutions on the basis of "if this is the data, then this is the solution".

But we as outsiders do not know enough about village systems. The rural situation is both com-

plex and dynamic. We simply do not have the systems to capture this complexity within useful time frames to enable feeding a computer so that models can be produced. There is also the added (and very great danger) of outsiders' priorities creeping into data-bases and models. GIS based market-forces models favoring cash crops can contradict sustainable food production models already functioning with village people. When such market forces models are backed by unquestioning faith and money for implementation, they are likely to contribute to increasing the very poverty that such models are designed to reduce.

We have shelved GIS at present, and decided to let local people analyze and provide solutions.

THE LESSONS

Rural Situations are Complex

The "community" is many subsets. The community is made up of many subsets: rich families, village based industrialists, large traders, large farmers, middle farmers, small farmers, artisans, petty traders, landless, the destitute, and the disabled.

The resource base of each subset is not the same. Each of these subsets use the local natural resource base. But the ownership of and access to the resource base of a large farmer is not the same as that of a poor farmer. The resource base of an artisan is different from the resource base of a trader.

Skills and knowledge differ. Each subset has its own skills and knowledge base which each uses differently on the resource base.

Levels of power differ. Each subset has some power to ensure that skills and knowledge can be applied to the resource base. This power exists at different levels. At the family level it can be used on the assets and entitlements of a family; at the village level it can affect the natural resource base; at the district/divisional level it can influence infrastructural issues (roads, bridges, water-shed development, agricultural supplies, etc.); at the zonal level, issues of allocation of resources can be affected; at the national and international levels, policies can be influenced.

THE PRA PARADIGM

Framework

PRA helps us to understand rural systems through five points:

1) *Spatial*: the physical environment, the natural resource base, infrastructure
2) *Time references*: seasonal changes, historical changes, trends
3) *Social*: caste & class differences, centers of influence
4) *Preferences*: the data-bases which govern choices
5) *Processes*: the steps by which activities are done

Search for micro-environments

The poor and the marginalized can be located by understanding:

1) *Borders:* edges of forests, lakes rivers (foreshore cultivation);
2) *Niches:* access to forest produce, gleanings, labor exchanges;
3) *Nests:* livelihood strategies which fit inside other strategies, like vines trained onto trees/fences/roofs, bee-hives under eaves;
4) *Patterns:* seasonal migration, planting/harvesting, use of commons;

Feedback

PRA helps in feedback. Feedback to village people needs to be in symbols that they understand. It must be timely i.e. the information in the feedback is still useful and that there is enough time to act upon the information.

VILLAGERS' MAPS

System-boundaries and issue domains

Village people have detailed knowledge of the rural systems they access. Since these systems are complex, some way is needed to focus on specific sub-systems or topics. One way is to define the domain of investigation by defining a system-boundary. Some of the systems are within the family domain. The system-boundary for family-level analysis can be set at the family. Most of the resources and opportunities are available at the village level. Therefore for village level analysis, the system-boundary is the resource base accessed by the village. Some opportunities exist outside the village, therefore the extent of the opportunity-shed will determine the system-boundary.

Mapping by villagers

Much of the information in a rural system is already public domain, information within the limits of the village. Village people are able to draw very detailed maps of village systems. They have mental maps of local conditions and realities. Facilitation processes enable village people to share their mental maps as real maps on the ground or on paper.

Villagers' maps contain micro-environments

Village people are users of local systems. Their maps reflect this. Patterns, niches, nests, and borders appear when investigated. Thus the current reality is observable (as against reality observed and interpreted some years in the past).

Villagers' maps provide effective feedback

Maps made by village people have their own orientation. They use symbols easily understood by most villagers. Since these are usually large and easily seen by several persons feedback is immediately available in the form of questions, and discussions. This leads to a better understanding by outsiders of village systems.

THE ROLE OF SATELLITE IMAGERY

Limitations of villagers' maps when mapping areas across many villages, PRA maps (and models) are very effective at the village-level for detail. But as increasingly larger maps are attempted, loss of detail on micro-environments occurs. Also there is an orientation problem, when several village level maps are assembled together in an attempt to form a larger picture.

Satellite image FCCs pull together villagers' map

FCCs of 1:25000 (one cm. equals one-fourth of a kilometer) provide sufficient detail for villagers to recognize roads, railways and surface water systems. This assists in establishing orientation and locations. Village-level maps made earlier can be brought together around the FCC to create a larger system of understanding. The FCC when used after local maps have been made can also be used as a feedback tool when negotiating the use of common resources used by many villages.

THE TEMPTATIONS OF GIS

It is very tempting to store all this information in a GIS package and to apply various "what if" models. But the way I see it, this could lead to top-down, non-participative, urban-biased, technical type solutions. Micro environments are not static. Livelihood strategies of the poor contain many variables. The only expert in this situation is the family which has been surviving in a particular micro-environment. Such families have the skill and knowledge to respond to changes in access to resources, seasonal variations and social pressures. Computer models would find it difficult to capture all the variables which influence rural decision making.

There is also the formidable problem of maintaining a data collection system which will update the variables in such computer models. Lead times (the time within which new information is usable) and lag times (the time taken for an action to be executed after receipt of information) would need to match those of villagers. This would be difficult in areas of rainfed crops where villagers' decisions may range from seed choices, to crop choices to out-migration, all within a time frame of three to four weeks.

It is also necessary to question the data that has gone into the GIS. It may sometimes be based on maps which may be very old and therefore not valid. It may have figures based on surveys which may not have addressed all questions of rigor. There is also the question, "whose analysis"? Often it will be a technical expert who has used visible data based on his own training and experience and arrived at positions/interpretations which then appear in the GIS as "truth". Aerial photographs and satellite-data may provide accurate bases for generating overlay-maps. These maps should then be interpreted by villagers. Therefore, the usefulness of GIS lies in its ability to produce maps. All subsequent decision making should be done by the people who would be affected by the decision. The GIS maps can facilitate such decision making.

SOME SUGGESTIONS

Topo maps provide a framework of reference both for PRA maps and models, and for satellite FCCs. FCCs of 1:50000 (or larger) are less useful than 1:25000, because local features become blurred making planning with people difficult. However, they provide more information than a topo sheet, and broad ecological zones can be identified.

Villagers are the most efficient in interpreting FCCs. There is no need, at our level of work, to incur the additional expense of interpretation by a multi-disciplinary team of scientists. When ordering a FCC, the geographical co-ordinates of an area and the marking of a location on a topo sheet must be done with great accuracy. We have had FCCs where project villages have been missed out on the edges.

CONCLUSION

Rural systems are complex. Survival strategies of the poor even more so because they depend on micro-environments. It is necessary to understand these micro-environments, which is made possible with the help of village-level maps made by villagers. Satellite imagery FCCs pull together many village-level maps which provide an understanding of the use of common resources across many villages.

In all cases, village-level mapping by villagers should be done first. This will ensure that villagers' mental maps have been conceptualized in a visible, understandable way. Satellite image FCCs of 1:25000 should then be presented to village people: first for analysis by them, later for planning by them across areas not covered by their village maps.

We find that it is useful to first get a FCC of 1:50000. This helps locate broad zones and assists in defining areas which need to be expanded to 1:25000 FCCs. This reduces error in both the subsequent placement of orders and the production of the 1:25000 FCCs.

The use of GIS should be limited to producing topical/thematic maps which can be used by villagers. Modelling "what-if" situations should be restricted to areas which are beyond the knowledge of villagers. The data-bases of such models must be established with care. Procedures of updating such data-bases would need rigorous attention.

Above all, we as outsiders, must learn to listen. Then we can understand local needs. Many times we as outsiders jump to solutions. Instead we must learn to define needs. For this we must learn to listen.

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Notes:

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References

Chambers, Robert. 1983. Rural poverty unobserved: the six biases, in Rural Development Putting the Last First, ISBN-0-582-64443-7, Longman-London, Lagos, New York.

Chambers, Robert. 1990. Microenvironments unobserved, Gatekeeper series No. 22, International Institution for Environment and Development, London, U.K.

Jamieson, Neil. 1985. The paradigmatic significance of rapid rural appraisal, in International Conference on RRA,

Khon Kaen University ISBN-974-555-251-8 Khon Kaen University, Khon Kaen, Thailand.

Joseph, Sam. 1991. Lead time, lag time, ACTIONAID discussion paper, ACTIONAID, 3 Rest House Road, Bangalore 560 001, India.

Joseph, Sam. 1991. Sustainable development niches and choices, ACTIONAID discussion paper, ACTIONAID India.

McCracken, Jennifer A., Pretty, Jules N., Conway, Gordon R. 1988. An introduction to rapid rural appraisal for agricultural development, International Institute for Environment and Development, 3 Endsleigh Street, London, WC1HODD, U.K.

Miller, Gary. 1985. Listening with my eyes, in Effective Family Communication, Interchurch Service Agency, 93, Pantheon Road, Egmore, Madras, India.

Mollison, Bill. 1990. Permaculture, a designer's manual, The Deccan Development Society & Perinaculture - India, Hyderabad, India.