

# Discussion paper on INRM within CGIAR in the future

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*Note: There has been no time to research or to confirm the points made here. An earlier review of NRM research for TAC may be useful in emphasising the importance of resource-centred research (Tinker and Anderson 1996).*

Basic 'Natural Resources' in this context means radiation (temperature), soil, water supply and biodiversity. It is useful to consider marine and freshwater ecosystems, forests, grasslands, mountains as derived Natural Resources, and farmland, managed forests and grasslands as human-influenced Natural Resources.

## 1. To change too much, too little, or just enough?

A fresh Science Council may imply a fresh review of existing work, and a temptation to cut out the old and start something new. INRM research is usually field based, and can only obtain dependable results slowly. A long period may be necessary to establish necessary conditions, or to average out climatic variations. It is therefore difficult to make rapid reversals of previous policy. Existing projects should be abandoned only if it has become clear that the objective is no longer important, or that the experimental approach is unsuccessful. Otherwise careful updating, to take into account new information or policy, is the way forward.

## 2. The Challenge Programs

CGIAR Centres have often found it difficult to work together efficiently. There has been too much committee control, leading to dispersion of funds by formula, and lack of incisive leadership. The Challenge Programs should be a big step forward, but SC needs to keep a sharp watch over their progress. This should not mean micromanagement, but a strong intervention if local management is not succeeding. The CGIAR cannot afford to let these Programs fail.

## 3. The impact of climate change

Before about 1998 it was assumed that practical impacts of climate change were a long way ahead. The gradual realisation that these changes are already observable and important is a major change in thinking, and means that the demands upon CGIAR will arise more rapidly than expected. Fortunately, the CGIAR has already planned a Climate Change Challenge Program, though I understand that it has not yet been implemented. The information papers on this Program that I saw during the review process have often been weak. They have also shown a refusal to accept that the Centres do not contain all skills, and that they should not expect to lead (and to get all the funding) in those areas where they have little experience. This is a failing that only the Science Council has the authority to correct. This Challenge Program must have the best people from the world-wide Climate Change science community, and all peer review must be carried out by a broad-based group of the best scientists in the subject. The Centres involved must do their best to join this world community, which is still rather weak in the tropical countries.

The forward projections from Climate Models have not changed radically over the last few years, which suggests that they are probably correct in broad terms. The problem is that agriculture is site-specific, and 'broad terms' may be inadequate. The new Scientific Council needs to keep this under continual review to ensure that the latest and best predictions for different parts of the tropics are used to guide research.

It is simplest to obtain climatic model predictions and work on the agricultural effects alone. However, if it has not done so already, the CGIAR should familiarise itself with socio-economic/physical models that attempt to predict the effect on a whole society, such as the IMAGE model (Alcamo et al. 1998). As far as I know, the CGIAR is very short of really good large-system modellers, and this needs correction. CGIAR has a great opportunity here, because most of the climate change work is based in temperate countries.

#### **4. The management of water for high efficiency of use**

The second INRM Challenge Program on Water and Food is also exceptionally important. There is a large interface between the two Challenge Programs, and again SC will need to keep a sharp watch to ensure that there is good collaboration. The structure of CGIAR is not favourable for top-down management, which sometimes is necessary. TAC was sometimes left to carry out this task, but I hope that the new SC will be better organised for it.

There are no really new basic aspects in the science of hydrology, as the equations of water movement and potential energy are well established. Irrigation efficiency is the critical measure of whether water is well transported and applied, and in many tropical countries it is used very wastefully indeed. IWMI has had long experience with this, but it seems to have been held back in the past by focussing solely on socio-economic questions. Further, it did not work on a large enough scale, usually because it did not have sufficient resources or authority within an experimental catchment to test new systems. Hopefully the new Challenge program, with its focus on the water relations of catchment areas, will correct this. The need for exact science and exact management occurs especially in catchments with erosion or salinisation. Modelling is the way forward, and IWMI has considerable skills in this.

The only new development in this that I am aware of is pedotransfer functions (Batjes, 1996). These are developed to allow the hydrological characteristics of soils that are needed for calculation and modelling of water behaviour but are usually difficult or expensive to measure, to be predicted from existing databases. This should make the application to large areas of the modelling methods much more practical.

#### **5. The development of farming systems that produce resistant soil structure and low erosion, and are therefore sustainable (Greenland & Szabolcs 1994)**

Erosion causes massive soil degradation, both by wind and water, and by soil loss and soil deposition. CGIAR already has good programs on this, e.g. at CIAT. It is difficult to envisage any very original methods of control, as a variety of methods are well known and extensively used. As in many Natural Resource issues, the problem is to ensure accurate and efficient application of known solutions to the site-specific

problems on large and heterogeneous areas. The problems of upscaling and downscaling are of central importance, and new mathematical approaches are available (Green & van Schilfgaarde 2002), though I am not personally familiar with them. More and better capacity building in the developing countries is needed to apply the principles and models that are already known. It is important to distinguish soils that are inherently resistant to degradation from soils that are resilient, and can recover their structure. The latter is often dependent upon soil fauna.

The possibilities of using agroforestry for control of erosion are well known, and must be used, but I am not aware of any great new development with new potential. Improvements in erosion control will depend upon good extension work and incremental improvement of techniques.

## **6. Plant nutrients**

The attitude to chemical fertilisers in the tropical agriculture community was in the past often surprisingly hostile, partly because of a belief that farmers could never afford fertilisers. These attitudes are disappearing now, and it is becoming accepted that a deficiency of nutrients is a very serious form of soil degradation, that has to be corrected, and that most nutrients need addition from other sources (Dudal, 2001). Nitrogen is the only nutrient that may normally be produced in situ, but there are some crops that fix only a small proportion of their N need.

It is surprising that CGIAR Centres seems to have done rather few nutrient balances except on rice, and even fewer on multi-crop farming systems, and more should be done. Having done such experiments, each process causing a loss of nutrients from the system needs research, so that more nutrient-efficient farming systems can be devised. Again, it is unlikely that major new breakthroughs will be found - the need is for good local understanding of the principles, and for reliable supplies of fertilisers, at reasonable prices, to be made available to farmers.

An important development from ICRAF has been the idea of supplying very large amounts of local rock phosphate to phosphate-deficient and phosphate-sorbing soils, so as to guarantee sufficient phosphate availability in the long term. If this is possible in practice, it should be profitable in the long term. A similar process has happened in Europe, where generations of farmers have accumulated phosphate in their soils.

## **7. The integration of farming into land use**

The attitude of the CGIAR to land use studies is not very clear. As far as I know, it does not strongly support 'land use' in its Centres, though the World Bank has taken a considerable interest. Land use is basically the determination of the most efficient and sustainable use of land for areas of complex mixtures of different land types and soil types. This means working on a scale larger than that usually considered by Centres, but it would integrate and utilise the results of their other studies. In particular, it would be valuable in relation to environmental issues such as landscape ecology and conservation. This subject only becomes important in practice when there is some control over land use, but this stage must eventually occur in most developing countries

## **8. Environmental and conservation issues in the CGIAR.**

It appears that CGIAR Centres lack expertise on the biological and landscape environment, with the exception of CIFOR and ILRI. The general priorities of Centres seem to be those of agriculture - for understandable reasons - and environmental issues such as erosion or water quality are well covered. However, there is a need to deal with wildlife, wild vegetation, and landscape value, and to build these into the agricultural context. Landscape ecology is now becoming an exciting discipline (Szaro & Johnson 1996), because the steady expansion of agricultural land in the tropics requires that conservation of both plants and animals shall be planned within the agricultural landscape. The CGIAR needs to make sure its Centres are able to deal with this type of problem.

## **9. Soil microbiology**

There is no doubt that this is the active frontier in soil research. Molecular methods have revolutionised a subject that was formerly very dull. The possibilities in this area are not known yet, but it is important to make sure that somewhere in the CGIAR there is high-class group working with these new techniques for microbes. Growth promoting rhizobacteria have often been isolated, but their effects have been irregular and unpredictable so they have not been used in practice (Tinker & Nye 2000). The application of arbuscular mycorrhizas, that infect virtually all tropical species, needs particular attention, as molecular genetics may produce new fungal strains that are more effective than the natural ones that have been used so far.

## **10. Conclusion.**

The CGIAR is well prepared for work in molecular biology, where it has a number of ongoing projects. I think it may be less well prepared in the other major development of the second half of the 20<sup>th</sup> Century, which is mathematical modelling. This is applicable in many disciplines, especially in INRM.

## **References**

Alcamo, J., Leemans R. and Kreileman E. (1998) Global change scenarios of the 21st Century - results from the IMAGE 2.1 model. Elsevier, Oxford.

Batjes N.H. (1996) Development of a World data set of soil water retention properties using pedotransfer rules. *Geoderma* **71**, 31-52.

Dudal R. (2002) Forty years of soil fertility work in Sub-Saharan Africa. In Integrated plant nutrient management in Sub-Saharan Africa. (Ed B. Vanlauwe et al.) CABI, Wallingford pp 7-22

Green T.R. & van Schilfgaarde J. (2002) Watershed approach, in Encyclopedia of Soil Science. (Ed R. Lal) M. Dekker, New York pp.1403-1407

Greenland D.J. & Szabolcs I. (1994). Soil resilience and sustainable land use. CABI, Wallingford.

Szaro R & Johnson D. (1996). Biodiversity in managed landscapes. Oxford University Press, New York.

Tinker P.B. & Anderson J. (1996) A strategic review of natural resources management research on soil and water. Consultative Group on International Agricultural Research, (SDR/TAC:IAR/96/9). Food and Agriculture Organization, Rome. pp. 63.

Tinker P.B & Nye P.H. (2000) Solute movement in the rhizosphere. Oxford University Press, New York.