IFA AGRICULTURE CONFERENCE

Optimizing Resource Use Efficiency for Sustainable Intensification of Agriculture

Kunming, China
27 February – 2 March 2006

INTEGRATED SOIL CONDITIONING FOR PRODUCTION AGRICULTURE AND ECOSYSTEM SERVICES

A tool to improve agro-productivity, food security and poverty alleviation

W. VAN COTTHEM [1)]
D. PATTIE [2)]
[1)]TC-Dialogue Foundation, BELGIUM
[2)] UNCCD, GERMANY

Tc-Dialogue Foundation, Belgium
United Nations Convention to Combat Desertification (UNCCD), Germany
Email: vancotthem@tcdialogue.be Email: dpattie@unccd.int

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"INTEGRATED SOIL CONDITIONING FOR PRODUCTION AGRICULTURE AND ECOSYSTEM SERVICES"

A tool to improve agro-productivity, food security and poverty alleviation

W. Van Cotthem
Honorary Professor University of Ghent
TC-Dialogue Foundation, Belgium

D. Pattie
United Nations Convention to Combat Desertification (UNCCD), Germany

INTRODUCTION

"*We don't know what we know*".

Human beings have always accumulated knowledge, first within the small circles of their villages or regions, later all over the world. When printing was invented, new possibilities of exchange of information through all kinds of publications became available. Exchange of information and transfer of knowledge have been leading to innovations. Very informal contacts can always produce valuable exchanges of knowledge.

Telephone, telefax and, more recently, new electronic technologies like computers dramatically enhanced these possibilities. Nowadays, the number of electronic networks, through which transfer of knowledge all over the world is only a matter of seconds, is continuously growing. The bulk of data is becoming so enormously big that, today, no one is able to manage all that knowledge anymore, not even in his or her own field of expertise. As a result, specialization occurs and "experts" in a certain field of knowledge have to narrow more and more their scope in order to be able to grasp the incredible progress made. Scientific experts are not longer general experts, like the agronomists, biologists, chemists or physicists of decades ago, but now they are pedologists, hydrologists, agro-chemists, agro-physicists, morphologists, ecologists, biochemists, microbiologists, geneticists etc.

Higher specialization creates automatically a bigger distance between experts and at the end of the day specialization became so extreme that experts, originally linked by their "general field of interest", e.g. agronomy or biology, are in fact not knowing anymore what kind of progress is made in other closely related fields. Even in our own field of specialization progress can be so quick that it becomes difficult to follow every step forward. "*We don't know what we know*", unless we produce a lot of efforts to scrutinize attentively and continuously the internet, the existing and newly created networks, the e-conferences and all other electronics ways of getting information. But do we have the time for all that?

"***Productive knowledge***"

The more the volume of knowledge is growing, the more the need is felt to transform it into something more productive than our theoretical knowledge itself. Knowledge can be transformed into products or services, e.g. agronomic knowledge into production agriculture or ecosystem services. The question is: how can we optimize this transformation? It can successfully be achieved by combining knowledge and skills of academic experts in appropriate fields, government representatives for financing, financial experts for risk capital, industrial experts for their enthusiasm concerning the practical outcome and entrepreneurs for the practice.

This is, of course, only a very general framework within which all kinds of practical forms of cooperation can occur. It goes without saying that combination of knowledge and skills (cooperation) of academic experts is the most logical and practical way to transform theoretical knowledge into products and/or services. Not all countries have the necessary expertise in every scientific domain and developing countries, on their way to sustainable development, should be involved, whenever possible, in such forms of cooperation towards productive knowledge.

NEED FOR INTEGRATION

During the last century, all different biophysical and socio-economic sciences have become extremely specialized. It means that all experts, in order to keep track with the evolution within their own field of interest have to focus their attention very strongly on a few points only. Research work is more and more concentrated on very specific issues.

The way a new airplane (a product!) is developed by a team of experts (its engines, electronics, doors, seats, air conditioning, wheels, toilets, windows, wings, tail, etc) is one of the nice examples of the need for integration of knowledge, expertise and skills. Without this integration it would be almost impossible to create such a complicated product. Somewhat of the same complicated order is the organization of an international conference. Years ago we could go to quite general conferences, e.g. on agronomy, botany, zoology, chemistry etc. Today, conferences focus on very specific themes. As a result, we all loose contact with other closely related disciplines, even within our own major field of expertise (soil physics, soil chemistry, soil microbiology, hydrology, …). Moreover, conferences are often split into different parallel sections and no one is able to absorb the transfer of knowledge in these sections: Micronutrients, Soils, Water, Land use, Nutrition, Technologies, Sustainable Management, Policies, …

It seems to us that there is only one good solution for this problem of growing distance between experts, namely **integration by forming multidisciplinary teams for interaction and scientific cooperation, while maintaining individual identity (competition).** We see different disciplines that can easily be combined: Soil, Water, Nutrients, Plants, Animals, Microbiology, Socio-economics,

An example for such a combination could be: **integrated soil conditioning** to simultaneously solving problems of soil, water, fertility, organic content, microbiology, aeration, poverty alleviation, etc. There is really a strong need for integration of different solutions developed by experts in these different fields (they know what the best practices and success stories are, they can tell us about the lessons learned, they can avoid not to invent the wheel anymore,).

KEY TO PROGRESS: INTEGRATED SOIL CONDITIONING

The United Nations have decided the year 2006 to be the International Year of Deserts and Desertification. The most important questions to address during this year are: how to stop land degradation in dryland rural areas, how to eradicate poverty, how to achieve sustainable development, how to reach the Millennium Development Goals (MDGs). All over the world, people are trying to channel resources to projects for combating desertification and alleviating poverty. Drylands cover about 41% of Earth's land surface and are inhabited by more than 2 billion people. Dryland populations on average lag far behind the rest of the world on human well-being and development indicators. Existing water shortages in drylands are projected to increase over time, due to population increase, land cover change and global climate change. Transformation of rangelands and other sylvipastoral systems into cultivated croplands is leading to significant, persistent decrease in overall dryland plant productivity. Among dryland subtypes, ecosystems and populations of semiarid areas are the most vulnerable to loss of ecosystem services.

The **Millennium Ecosystem Assessment (MA)** report on drylands, released on 19 January 2006, considers that some 10–20% of the world's drylands suffer from one or more forms of land degradation. The MA was launched by U.N. Secretary-General Kofi Annan in June 2001 and was completed in March 2005. The report is an international work program. It was designed to meet the needs of decision makers and the public for scientific information concerning the consequences of ecosystem change for human well-being and options for responding to those changes. It will help to meet assessment needs of the Convention on Biological Diversity, the Convention to Combat Desertification, the Ramsar Convention on Wetlands, and the Convention on Migratory Species, as well as needs of other users in the private sector and civil society. The MA synthesizes information from the scientific literature, datasets and scientific models, and it includes knowledge held by the private sector, practitioners, local communities and indigenous peoples.

Desertification is undermining the fertility and productivity of all drylands. It creates food insecurity and famine for more than one billion people. Governments, many international organizations, the civil society and the local people themselves, all try to reverse that trend of deterioration. But, what is the key to progress? We think that this key could be found by using **modern technologies** to transform agriculture and to create new jobs, combining those modern technologies with **traditional methods** and by adapting them to **local conditions.**

According to the MA report, in the African Sahel region, once considered the centerpiece of the desertification paradigm, land users are achieving higher productivity by both intensifying and improving their land management practices, by capitalizing on improved organization of labor, more extensive soil and water conservation, increased use of effective soil conditioning, with less mineral fertilizers and manure (see e.g. the TerraCottem method).

But what does the Millennium Ecosystem Assessment tells the Agribusiness? It states that food production has doubled over the last 40 years, but nearly 1 billion people remain under-nourished. The MA predicts that the demand for food, and other goods and services produced by agriculture, will double over the next generation. Combinations of population, economic and urbanization growth will drive these demands, which will undoubtedly diversify.

They must be met by using less water (e.g. applying water absorbent soil conditioners like TerraCottem), not occupying additional land and doing all this in competition with the expanding needs of conservation, infrastructure and urbanization. These changes are, and will be, driven by markets (consumers), the public opinion and regulations.

Production agriculture has had a major impact on the ecosystems of the world. Many ecosystems have been damaged, particularly though intensive production systems, and the over use of marginal and fragile ecosystems. However, the demand for a full range of **ecosystem services** is projected to double over the coming years. The MA tells us that these demands must be met without further degradation and with the restoration of damaged ecosystems. This presents both opportunities and threats for agribusiness, in which integrated soil conditioning can play a very important role.

The challenge to increase production, while restoring ecosystems, will necessitate and create markets for new technologies and management systems. However, new technologies, while helping, will only work if supported by integrated management practices, effective institutions and realistic policies. This points towards agribusiness taking a wider interest in management systems and rural institutions, while contributing constructively to policy development.

All possible solutions will still require investment by the public sector, business companies and the industry in methods, technologies and programs aimed at building awareness, developing skills in systems for impact assessment, monitoring and identifying the best practices. These technologies should be safe, reliable, cost-effective, profitable and affordable. They will need to be built into a range of low impact or organic production systems, as well as more intensive systems that will be needed to satisfy the growing demands.

Within such a framework, scientific collaboration and integration of methods are urgently needed for:

- Soil conditioning
- Water harvesting and Water Use Efficiency (WUE)
- Drought and salt tolerance
- Improved seed production
- Pest resistance
- Post harvest management

AN EXAMPLE OF INTEGRATION: THE TERRACOTTEM-METHOD

At the University of Ghent (Belgium), we have integrated the available knowledge and expertise in different fields to find a universal solution for drought problems, some fertility and other soil problems, root growth problems, microbiological problems and soil aeration problems.

In order to solve the drought problems, we have selected a number of hydroabsorbent polymers. These synthetic and natural polymers not only stock water, but also nutrients. They even contribute to the solution of some soil problems by agglomerating soil particles. Mixing NPK-fertilizers and slow release fertilizers with the polymers offers possibilities to stock macro- and micronutrients, thus avoiding some leaching. To the granular mixture of different water absorbing polymers and mineral fertilizers, some powdery substances were mixed. These are easily absorbed by roots, in which they are transformed into root activating substances. Some additional organic substances stimulate the microbiological activities of the soil. Finally, organic rock or lava contributes to the fertilization and the aeration of the soil.

Hopefully, this short description has made clear that the TerraCottem-method is not based on a classical way of doing research work. Normally, one or another expert would concentrate his or her research work on e.g. water absorbing polymers and develop knowledge, skills and expertise only in this field of polymers. Other specialists would concentrate on fertilizers, on organic matter, on hydrological aspects, on microbiology, on aeration. But only rarely, expertise of all these different fields has been combined in one single research action towards a universal solution of different problems with one single action, namely to mix the TerraCottem compound to the upper 20-30 cm of the soil (the rooting zone with most of the absorbing roots).

Therefore, it should be underscored that the TerraCottem-compound of granules and powders is not just one single hydrogel, but a well-balanced mixture of more than 20 different components, acting in synergy to provide a total soil improving compound of:

- Natural and synthetic organic water absorbing substances (polymers)
- Mineral fertilizers: macro- + micro-nutrients (soluble and slow release)
- Organic substances to stimulate micro-organisms
- Root growth activators
- Volcanic rock (lava)

In an **integrated** way it optimizes simultaneously:

- Soil moisture content,
- Water use efficiency (WUE),
- Soil nutrient content,
- Microbiological activity,
- Root growth,
- Soil aeration,
- Plant production and yield (income).

HOW IS TERRACOTTEM WORKING?

1. It stocks water with a mixture of different **hydroabsorbent polymers**

- Natural ones: derivatives of starch and cellulose
- Synthetic ones: copolymers of polyacrylamide and polyacrylates.

2. It delivers **macro- and micronutrients**:

- Mixture of soluble NPK-fertilizers (starter component)
- Mixture of slow release fertilizers (8-12 months).

3. It delivers a **slow release nitrogen source** through some organic substances,

- stimulating microbiological activities.

4. It activates **root growth,**

- through introduction in the soil of activating substances (precursors of cell elongation hormones).

5. It contributes to **soil aeration,**

- through introduction of volcanic rock (lava).

6. It enhances **plant production (yield),**

- through the synergetic effect of all different components (polymers, fertilizers, organic substances, microbiology stimulators, root growth activators, volcanic rock).

7. It offers to **rural people in the drylands**:

- More **food security** (better public health)
- Higher **annual income** (poverty alleviation)
- More **labour chances** (limits rural exodus)
- Positive influence on **socio-economic factors.**

TERRACOTTEM APPLICATIONS

Although originally developed to solve different problems of the drylands, a number of application fields have been developed since the commercialization started in 1992 (www.terracottem.com):

- Agriculture - Horticulture
- Forestry - Agroforestry
- Sand stabilization - Salinity
- Sports turf
- Landscaping - Gardening
- Roof gardens
- Humanitarian projects in drylands (www.tcdialogue.be).

CONLUSION

The explosive development of all sciences and the massive transfer of knowledge, stimulated by the development of electronic networks, impose on all scientists and experts the need for specialization.

It has become totally impossible to keep track of every new finding in the scientific world. Therefore, it is highly recommended to orient future research work into integrated actions, with participation of teams of experts, all having their proper knowledge and expertise in one of the related fields.

Integration by combination of efforts, instead of competition for resources, is the key to progress and to success on our way to find solutions for the most important biophysical and socio-economic problems of this world.

Integration of capacities seems to be the best solution for production agriculture and ecosystem services.

Integrated soil conditioning is one of the keys to progress.

THE AUTHORS

Willem VAN COTTHEM
Honorary professor University of Ghent (Belgium)
President TC-DIALOGUE Foundation
Beeweg 36
B9080 ZAFFELARE (Belgium)
E-mail: vancotthem@tcdialogue.be
Website: www.tcdialogue.be

Douglas PATTIE
Environmental Affairs Officer
United Nations Convention to Combat Desertification
Haus Carstanjen
Martin-Luther-King Strasse 8
53175 Bonn, Germany
E-mail: dpattie@unccd.int
Website: www.unccd.int