

**Land Management for Australian Cotton
– a multiple output system delivering positive spillover
benefits**

Final travel report to the Cotton Research
and Development Corporation.

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October 1999

Department of Natural Resources
Queensland

This publication was prepared for the Cotton Research and Development Corporation, the general information of officers in the Department of Natural Resources, Queensland (DNR) and interested persons in the agricultural community.

It may be distributed to other interested individuals and organisations.

Grateful acknowledgment is given to the Cotton Research and Development Corporation (CRDC) for providing a travel grant and to DNR for permitting conference leave.

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Copies of this publication are available from:

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DNRQ990147

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Background

Dr McGarry (DMcG) attended the International Conference on "The Multifunctional Character of Agriculture and Land" in Maastricht, the Netherlands from 12-17th September 1999. The Australian Cotton Research and Development Corporation provided travel finances. The Queensland Government granted conference leave. The Conference was organised by the Food and Agriculture Organisation (FAO) of the United Nations and the Netherlands Government.

Attendance at the Conference was by invitation-only. Participants were designated, senior experts from invited governments and non-governmental organisations. DMcG was officially invited to the Conference by the FAO and the Netherlands Government, specifically to present his Case Study. The invitation came through the office of the Federal Minister for Agriculture Fisheries and Food, Canberra as DMcG was part (1 of 2 people) of the official Australian delegation to the Conference.

About 260 participants attended the conference from more than 130 countries and 30 government and non-government organisations.

DMcG had contributed to all parts of the initial, *email* phase of the conference from March to May 1999. Contributions included both responses to questions posed to the international scientific community on the multifunctional character of Agriculture, as well as a full case study that DMcG submitted on novel practices of land management in the Australian Cotton Industry (Attachment 5).

DMcG's case study was selected for oral presentation at the conference. A total of 147 case studies had been submitted world-wide and DMcG's presentation was one of only three selected for presentation in the Plenary session of the Conference. In total, only 14 case studies were selected for presentation at the Conference with most of these being presented to small, regional groups in Conference sub-sessions.

In preparing his talk for the Conference, DMcG had several discussions with senior staff of the FAO Section of the International Branch of the office of the Federal Minister for Agriculture Fisheries and Food, Canberra. Staff reviewed several drafts of DMcG's talk to ensure themes were consistent with the Australian Government's broader position on matters to be raised at the Conference.

The conference - themes and procedures

The conference attracted approximately 260 delegates, representing almost all World countries, to discuss and exchange experiences, thoughts and opinions on questions related to agriculture and land resource management in the coming century. Policy makers from the world's countries dominated attendees though agricultural and environmental experts were present to ensure technical veracity.

The principal tasks of the conference were to:

- review progress in the context of agriculture and related land-use towards the principles contained in the United Nations Conference on Environment and Development, Rio de Janeiro – specifically, the Declaration on Environment and Development Agenda 21: “Program of Action for Sustainable Development”;
- identify new practices and the necessary enabling environments that will lead to less degradation and ultimately to sustainability;
- identify the main issues to be addressed, taking into consideration the continually evolving nature of agriculture and related land-use.

The second objective introduced the main theme of the conference - to discuss the Multifunctional Character of Agriculture and Land (MFCAL). MFCAL is closely related to and grew out of the 1990's theme of “Sustainable Agriculture and Rural Development” (SARD) that was characterised by “sustainable development in the agriculture, fishery and forestry sectors that conserves land, water, plant and animal resources, and is environmentally non-degrading, technically and economically appropriate, economically viable and socially acceptable”. SARD issues and goals have been discussed at various levels, including (i) the 1991 Den Bosch Declaration on SARD, the goals of which were further elaborated in (ii) chapter 14 of Agenda 21 of the Rio Earth Summit on “Promoting SARD”, and (iii) special country reports, prepared in 1997, on natural resource aspects of SARD to a special session of the United Nations Commission for Sustainable Development (CSD) to assess interim progress toward Agenda 21.

MFCAL, as defined pre-conference by the organisers, is the “entire range of associated environmental, economic and social functions of agriculture”. The concept encompasses all the multiple goods and services generated by agriculture and related land-use. Analysis of the multifunctional character contributes to understanding the combination of potential synergies and trade-offs necessary to achieve sustainability in agriculture and rural development. MFCAL is seen as an analytical approach to help capture the complex and ever changing nature of agriculture and land-use.

Conference procedure followed United Nation rules in that the plenary sessions of the meeting were “interventional” in nature - where each country delegation was given the floor for no longer than 3 minutes to present their views on the MFCAL concept. Then, the International Governmental and Non-Governmental Organisations were given the floor in pre-determined order. Additionally, on each of two days Regional Groups met in smaller rooms to discuss regional issues, to be reported back in the next plenary session. A series of mid-conference excursions were organised, permitting delegates to visit local agriculture and agricultural industries of pertinence to the conference theme.

The major output of the conference was the Chairman's Report and delegates, through the interventional procedure and the Regional Group reports, had major input into and control of the final wording of this document (Attachment 2).

Case study presentation

DMcG presented his case study on Day 3 of the conference. The presentation was the first of only three papers given in the Plenary session to the full conference delegation. The talk was a PowerPoint presentation of 45 slides and DMcG was the only delegate to present a talk at this level of technology - a fact well received as the majority of the delegates relied on the four language, concurrent interpretation of the talks.

A full script of the talk is attached (Attachment 1). Interested persons may send DMcG a CD to receive a copy of the PowerPoint presentation (9 MB). In addition to the oral presentation of the talk, the case study was presented in three different forms for the conference delegates and those participating in the conference through the World Wide Web:

- (i) each delegate received a Case Study Fact Sheet (Attachment 3) that summarised each of the Case studies to be presented;
- (ii) after the oral presentation, DMcG's talk was presented both in the Sustainable Development's "Daily Report" to the Conference (Attachment 4); and
- (iii) on the conference's World Wide Web site as a summary of the talk, a photo of DMcG presenting the talk and a "3-minute sound-bite" of DMcG presenting the talk. These may be found at: <http://www.fao.org/mfcal>. Then press the "Images from Maastricht" button and go to the reports of 14 September.

The Chairman's final report

A large proportion of time in the Conference was given to reaching agreement on the wording of the Chairman's final report. As this report was the final outcome of the Conference, delegates carefully considered if the content reflected their countries' stance on SARD and MFCAL, and whether the document truly represented the discussions and outcomes of the meeting. The process to arrive at the report was both transparent and participatory, drawing from presentations and discussions at plenary and regional levels.

The report will be presented at many forthcoming meetings:

- (i) It will be part of a FAO information note to the FAO Council and Conference for discussion at FAO Council in November 1999. The Council can recommend elevating the document's status to a discussion document at the FAO Conference in November 1999.
- (ii) The Netherlands' Government will present the report to the Eight Session of CSD in April/May 2000 and will request that the document be considered as an official document for these meetings.
- (iii) The Netherlands' Government will also present the report to the 116th Session of the FAO Council and the 30th Session of the FAO Conference.

There were several contentious areas. The major ones follow.

- Several delegates believed that the MFCAL approach added nothing to SARD. Partly, this was due to the perceived ill-definition of MFCAL including the nature of the indicators necessary for its implementation and monitoring.

- Many delegates said there was nothing new in the concept. They considered it may solely contribute to a renewed awareness of and further reflection of the interlinkages among the different aspects of agriculture, toward further development.
- MFCAL may have merit as an analytical tool, alone – to implement SARD. MFCAL is not an objective on its own, rather it should be used as a framework for analysis and description of functions, eg to show interactions and synergies.
- Key objectives through MFCAL need to be food security as well as the reduction of land, air and water degradation.
- Countries varied widely in their view of the nature, need for and potential efficacy of MFCAL. There was at times heated debate on the nature and role of MFCAL as seen by different countries and NGO's.
- Many countries believed there was a “hidden agenda” behind the implementation of MFCAL. There were several suggestions that MFCAL was a disguised tool to serve vested interests, specifically the agricultural trade interests of some countries. Many delegates stated that rich countries should not be allowed to use MFCAL as an excuse to erect barriers to imports from developing countries.
 - An example may serve to highlight potential fears of the delegates. A European country is considering introducing trade barriers to maintain multifunctionality of one of its prime industries. Dairy production is important in the country but the aesthetically pleasing farms also attract tourists with their tourist dollars. The dairy industry approached the government to assure their continued existence (through trade barriers), arguing that a declining dairy industry would have serious effects on income from tourist dollars. So, multifunctional characteristics or requirements have the potential to lead to trade barriers.
- Several countries stressed that lack of secure land tenure rights inhibited the possible adoption of MFCAL. Farmers without sound land ownership have no gain in improving multifunctionality. In fact, improving land quality may lead them to losing their land, to a higher bidder or “influential” third party.

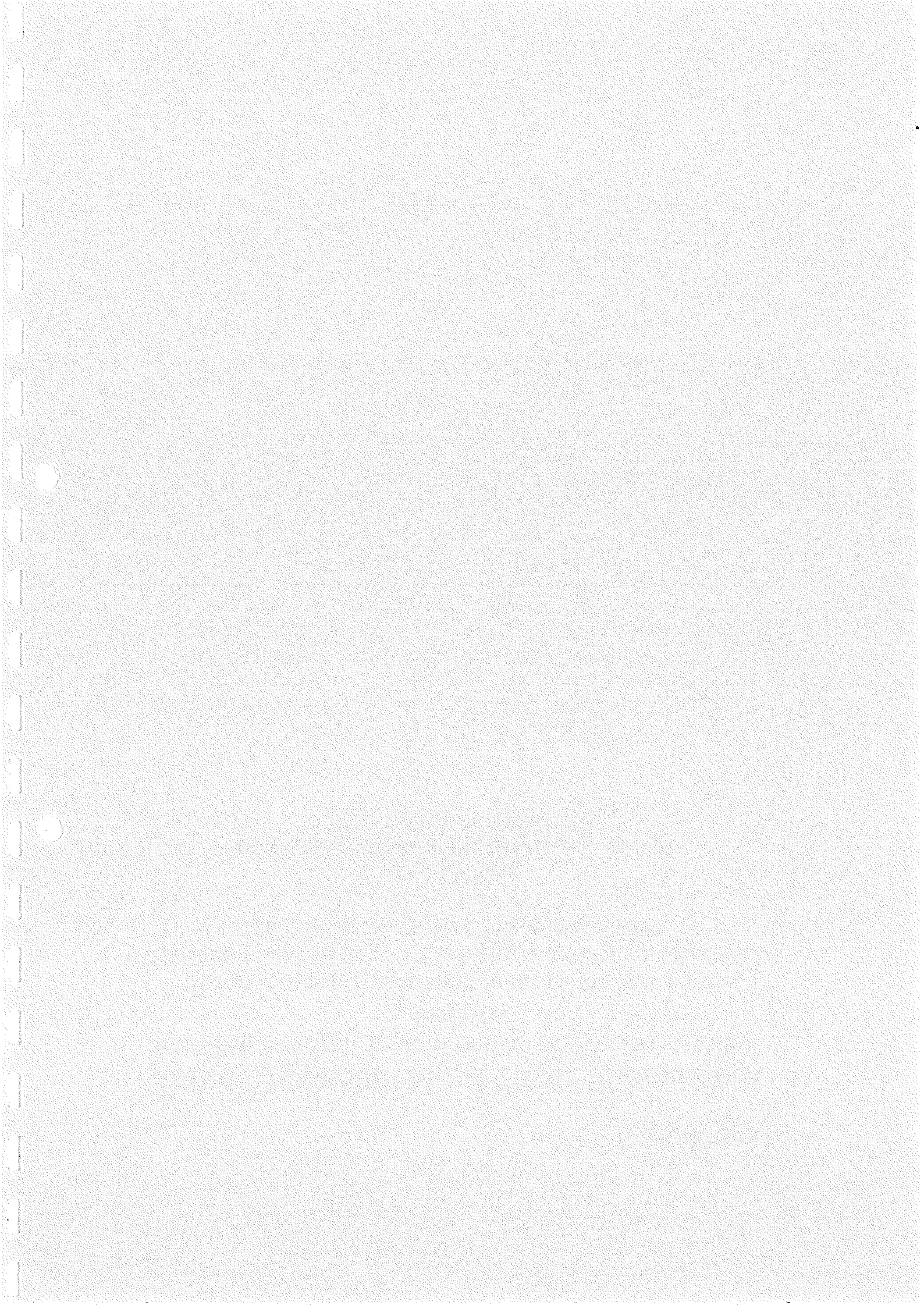
Attachment 1

Land Management for Australian Cotton **- a multiple output system delivering positive spillover benefits**

**Script of a paper presented to the conference on the
Multifunctional Nature of Agriculture and Land, Maastricht,
the Netherlands, 12-17 September 1999.**

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Background

Cotton covers 0.5 million ha of premium cropping land in Australia, contributes Aus\$1 billion per annum in export earnings, is the leading producer of cotton in the Southern hemisphere (approx. 2.5 million bales a year) and is the World's 3rd largest exporter of raw cotton. Cotton in Australia is a high intensity, capital intensive, high cost farming enterprise with a large and complex infrastructure that exerts great demands on land and water resources.

Over the last two decades, cotton in Australia has become a prime example of a multiple output system. Cotton is now a fully integrated farming system designed to complement the specific nature of the industry's soil resource toward multiple cropping with no land degradation, maximum water use efficiency, minimal costs and reduced farmer workload.

Geographic area and soils

Australian cotton grows predominantly in the semi-arid to sub-humid agro-ecological zone (Fig. 1). Most cotton grows on the flat plains to the west of the Dividing Range on some of Australia's prime cropping soils. These are cracking clays or Vertisols (as they are termed, globally). Eighty five percent of cotton grows on these soils that are characterised by high clay content and "highly active" clay. The most apparent outcome is strong cracking on drying.

The start of new land management initiatives

Cracking clays are something of a paradox. On the one hand, they are inherently most fertile with, chemically, good inherent nutritional status and, physically, good capacity to

hold large amounts of plant available water for extended periods of time. However, the paradox is that when wet these soils are in a most fragile (physical) condition – being most plastic and readily re-mouldable. Under irrigated conditions, the soils tend to be wet almost all year.

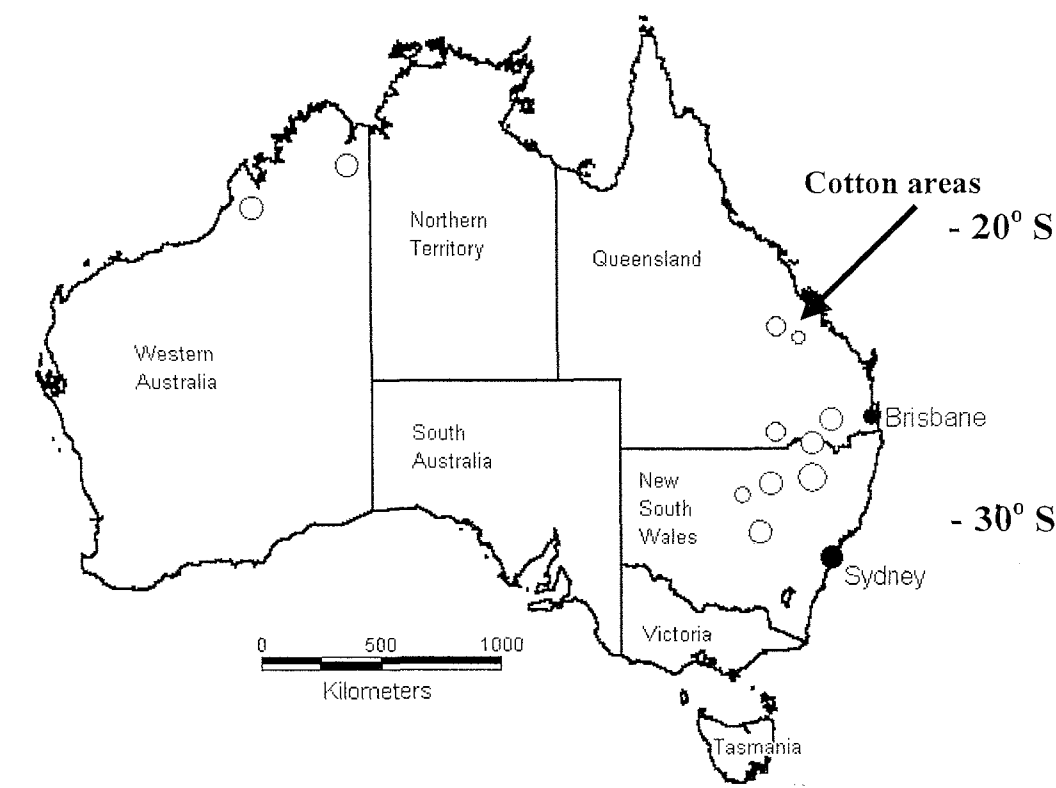


Fig. 1 The generalised location of the principal cotton growing areas of Australia.

The physical fragility of Vertisols was poorly understood in the early days of Australian cotton production (in the 60's and 70's). Generally, at that time large tractors and track vehicles were used for intensive, deep cultivation. Also, beds were removed and rebuilt annually, following the cotton harvest.

The general outcome was widespread soil compaction. Also, land management in wet winters was most difficult if beds had to be re-built in wet soil. McGarry (1990) presented an example where the building of beds in a wet year contributed to dramatic yield reductions in the subsequent crop. More generally, McGarry (1987) demonstrated the yield decline and soil compaction associated with wet land preparation. On a regional basis, McKenzie et al. (1992) presented data showing yield reductions of up to 50% in cotton crops following wet harvesting and bed building (Fig. 2).

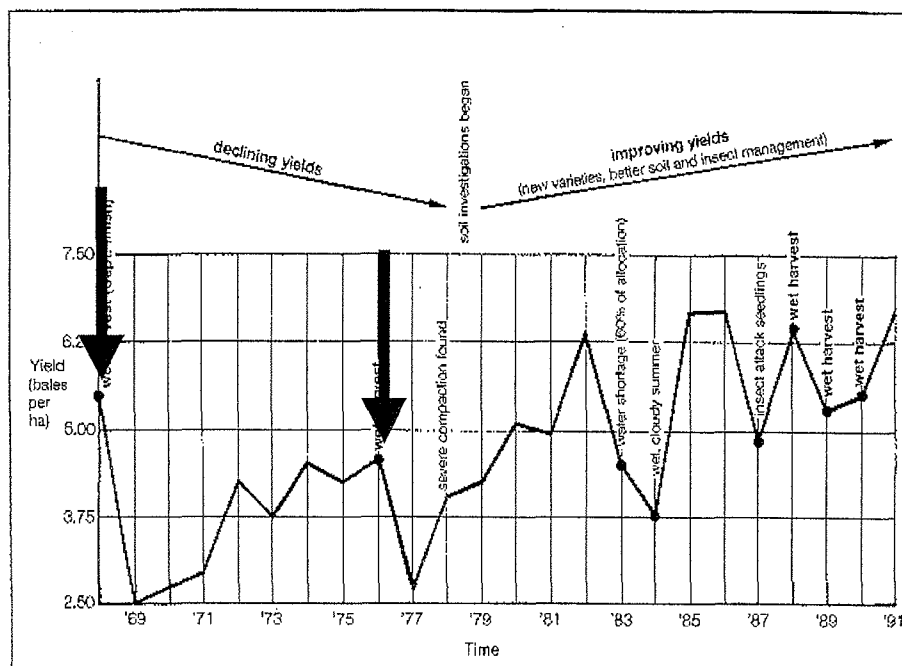


Fig. 2 History of cotton lint yield and associated soil problems in the Macquarie Valley, NSW, Australia. The arrows pinpoint two separate cotton harvests conducted in wet soil, each followed by a decline in cotton lint yield in the following season. One bale of cotton weighs 225 kg. (From McKenzie et al., 1992).

The response of the cotton industry

The cotton industry responded to reduced yield and difficulties of bed preparation in wet years by introducing the “retained bed system”. The system has five essential points:

- (i) The new system was based on the fact that cotton farmers recognised the need to better integrate their land management with soil type and the cotton cropping system.
- (ii) The principal aim of the new system was to retain plant lines (beds) between seasons.
- (iii) In the early phases, the system was achieved through growers re-configuring equipment to lead to what now is an integrated controlled traffic and minimal till system. Alterations to equipment were conducted in growers’ workshops - often invalidating tractor and equipment warranties.
- (iv) Beds were only shallow-cultivated and re-shaped (built-up) before pre-sowing irrigations.
- (v) Rotation crops were planted into existing beds to crack and aerate the soil to “naturally” improve soil health for the subsequent cotton crop.

Immediate effects

In terms of reducing and controlling soil compaction, the retained bed system was most successful. McGarry (1996) presented an example where the soil structure of a row and immediately adjoining (1 m apart) furrow (inter-row or traffic zone) from a field where the new system had been enacted for two years (Fig. 3). Evident is the strong difference in soil structure between the two locations. The inter-row (wheel track) is most compact, evident as a shallow seed bed with strong plate-like horizontal structure beneath. The plates are up to 0.02 m thick and very dense. In contrast, the plant bed exhibits a loose granular seedbed to 0.05 m then wide continuous cracks to at least 0.24 with abundant pore space between the cracks. Important is that the structure in each zone is optimal for its role – strong, dense “road” material in the inter-row and strong potential for germination and deep rooting in the plant bed.

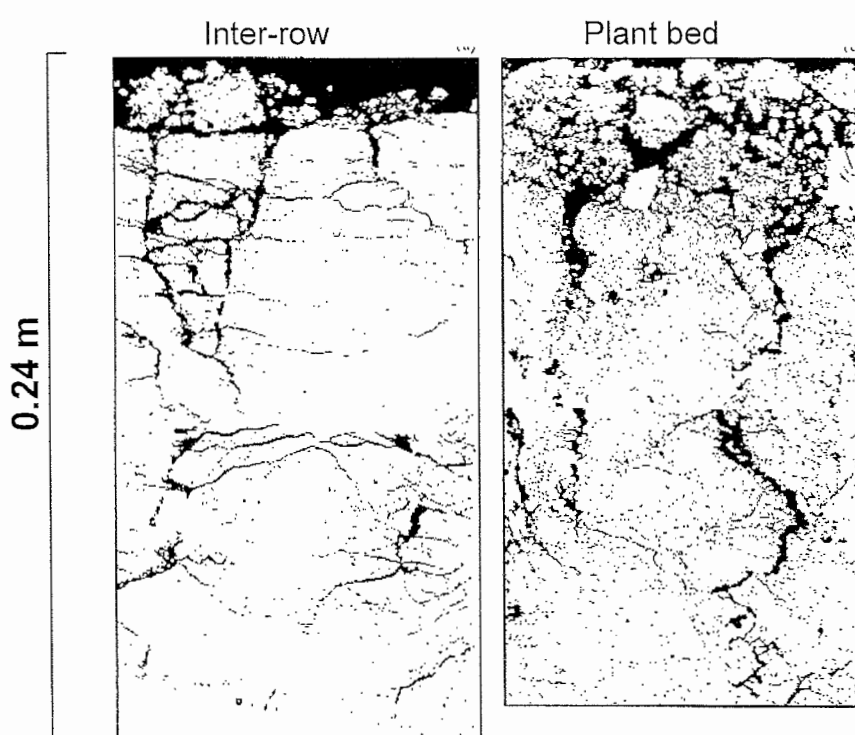


Fig. 3 Two images of soil structure from a cotton field near Pittsworth, Queensland, Australia. These are computer-generated binary images of resin-impregnated, intact soil blocks. In the images, the soil pores (air spaces) are black and the soil solids are white. The samples were taken just before cotton picking in 1991 from each of the furrow (inter-row) and the immediately adjoining row (plant line). From McGarry (1996).

Support for farmers attempting the new system was strong from the outset and the role of the Cotton Research and Development Corporation (CRDC), and then the Co-operative Research Centre for Cotton grew accordingly. In addition to providing financial support, the CRDC also initiated and supported multidiscipline approaches, accessing soil,

engineering, agronomy, etc disciplines to provide complete and integrated land management solutions.

An important support mechanism for the new system is the SOILpak manual (McKenzie, 1998). The manual has led to routine on-farm soil management programs based on soil pit inspections and the interpretation of soil chemistry data.

Machinery and tractor manufacturers now supply pre-built machinery, configured for the system. Tractor and harvester guidance systems developed in cotton are now commercially available to simplify establishment and maintenance of the controlled traffic system (Schoenfisch, 1998).

In summary, the basis of the change to the new system was a change in farmers' perception of their soil resource that led to altered land use practices that were more in tune with the land resource, hence more sustainable.

However, the change to the new system led to much more than this.

Multiple outputs from the system

Eleven other types of outputs have been identified from the system. Information on many of these is anecdotal but could be substantiated and quantified with further study.

- (a) Farmer driven. Farmers initiated the alteration of their tractor, tillage and harvesting equipment – most often in their own sheds – to achieve the new system. On many occasions farmers were voiding manufacturer warranties by altering equipment in this way. This demonstrates the farmers' strong commitment and belief in the positive aspects of the system. Only in the last few years have manufacturers altered equipment designs and provided equipment compatible with the retained bed system.
- (b) Increased resource awareness. Farmer awareness of the soil resource has increased dramatically over the last 15 years. There has been a strong move from a "mining mentality" with the view that "all these soils need is a good ripping" toward working in harmony with the known fragility of their soil resource. Farmers have accepted that their soil is fragile and responds best to careful management.
- (c) Greater crop diversity. The new system broke the cotton monoculture prevalent in the 1970's. Then, the author witnessed examples of fields that had grown up to 17 years of back-to-back cotton. Now, break crops fit well with the new system especially to enhance soil structure condition for the subsequent cotton (cash) crop. Break crops increase the number of wet – dry cycles and introduce non tap-rooted and nitrogenous crops to the system. These may be harvested but more often are incorporated pre-cotton to enhance soil organic matter.
- (d) Science support. Initially, science led the recognition and rationalisation of structure degradation prevalent with the "old" system (Chan, 1982; McGarry and Chan, 1984; McGarry, 1987; Daniells, 1989). This gave the basis for farmer education packages to begin to give a basis for problem resolution. Important was the packaging of several disciplines to present a complete breakdown of the problem to the farmers –

engineers, agronomists, entomologists, soil scientists, extension staff, etc. Participatory farmer training workshops were essential to the rationalisation of the problem and the support of farmers in its resolution. Central to this was the development of the SOILpak manual (Daniells and Larsen, 1991; Daniells et al. 1996) now revised by McKenzie (1998). SOILpak presents a fully integrated, step-wise program for recognising and resolving land management difficulties. SOILpak has been vital to empower farmers and their agronomists to assess and demonstrate the ongoing positive impacts of the new management system. There have been up to 20 SOILpak training workshops for farmers and their agronomists over the last 15 years (McGarry, 1991, 1992, 1999; McKenzie and McGarry, 1999).

- (e) Cotton Research and Development Corporation (CRDC) initiatives. All of the work leading to and supporting the new land management system has received empathy and financial support from the CRDC. CRDC funds are composed of a grower levy with matching Commonwealth Government Grants. CRDC has taken the initiative to focus and present the needs of the cotton farmers they represent and to seek out projects that best address them. In the current context, CRDC supported and financed all early scientific trials on compaction recognition and resolution, the production of both versions of the SOILpak manual, as well as the courses run to teach its use.
- (f) Time efficiencies. At a practical level, the new system has given large efficiencies in land preparation time by removing the need to annually remove and then rebuild the cotton beds. Also, deep ripping is now a most rare event - usually only performed every 5-10 years after laser levelling of fields. Less cultivation has led to greatly reduced pressures on operators. In the past, especially in wet years, there was great pressure on farmers to complete land preparation before they could pre-irrigate, fertilise and sow. Farmers now have more time to concentrate on other parts of their farming enterprise like irrigation scheduling, channel maintenance, weed control, etc.
- (g) Cost efficiencies. Less tractor use has greatly reduced fuel bills. Also, tractor life is extended as not only is the tractor being used less often but also it no longer has to deep-cultivate. Tractor replacement costs are reduced as the tractors on cotton farms are now smaller, again because the need to deep cultivate has been removed. One example is that the large crawler tractors once used for deep cultivation and bed-building on many large cotton farms are no longer seen. Additionally, tyre sizes (particularly width) have lessened on cotton tractors to help keep the soil compaction in the centre of the furrow and out of the bed. At another level, less fuel use means less greenhouse gas emissions - an environmental saving.
- (h) Local town economics. Reduced costs from the new system have led to greater disposable income. This has led to greater spending potential in local towns, particularly evident in the growth and maintenance of fabrication works and farm supply businesses. The former received and continue to receive increased orders to support alterations to farm equipment to suit the new system.
- (i) New technology. With the new system came a demand for advances in associated technology. New equipment design has been mentioned. In the mid- 1980's there were many advances into 8-, 12- and even 24-row equipment. Cotton pickers have gone from 2-row to commonly 4- and now even 6-row capability. Common axle lengths on all field equipment are essential to the system so that no tyres run on the beds. Extending picker and harvester (for winter wheat crops) axles was a challenging

task. Guidance systems for tractors and cotton pickers were developed and now commercialised. These are essential to assist farmers establish straight rows, and then to ensure all tyres run in the centre of furrows. Such developments led to many engineering appointments and the development of local fabrication industries. These personnel are now in a good position to develop and sell equipment to cropping industries who wish to follow the cotton lead by initiating controlled traffic and minimum tillage (eg grains and sugarcane).

- (j) Socio and family implications. Discussions in several cotton households lead to the following anecdotal points. The new land management system for cotton has stopped “recreational tillage” in the cotton industry. Cultivation in the old system tended to be excessive and conducted for ill-defined reasons, and generally led to across-farm soil compaction. Additionally, reduction in tractor hours has given greater time for farmers (who are predominantly the male family members) in other areas. These not only include other farm business but also, potentially, include more “family time”. This includes aiding other family members in routine household chores and child care.
- (k) Carry over to other industries. Several industries have witnessed the multiple outputs gained by cotton with their new land management system and are actively trying to enact comparable systems. The Australian Grains industry has already widely adopted zero and minimum tillage techniques and is now rapidly adopting controlled traffic, where like cotton, all wheels always run in the same, designated areas. The successful combination of minimum till and controlled traffic should give grains a parallel system to that of the cotton industry. Sugarcane is actively investigating alternate land management systems to replace the conventional “plough out” ie the complete cultivation of a cane field after harvest of the last ratoon in preparation for the plant cane crop (McGarry et al. 1998; Braunack et al., 1999). Trial techniques include removal only of the old stool either by cultivation or herbicide, and planting back into the “retained” bed location. Additionally, Australian cane is investigating wider row spacings to facilitate common axle widths on planting, harvesting and haul-out equipment.

Discussion

The retained bed system works well in Australian cotton. It is a system far better tuned to the known, physical fragility of cotton soils. The old system was a high-risk system as there was an inbuilt necessity to cultivate in wet years, leading to widespread soil compaction with subsequent reduced yields and difficult farming conditions. Important in the new system is that yields have not declined. Rather, they are guaranteed annually as the risk of inducing soil compaction has been dramatically reduced. Additionally, costs have been greatly reduced. Tractor size, fuel usage and tractor hours are all less. Tractor life is extended greatly. Increased disposable income reduces loan repayments as well as ensuring the viability of local commercial enterprises. Decreased tractor hours have had strong social implications - decreasing work pressures and increasing family time.

On a wider note, Australian cotton has demonstrated that increased mechanisation is not a panacea for increased productivity. In fact the opposite may be true. As cotton has realised, it is most important to properly match your land management with the inherent properties of the soil(s) you are farming. In mechanised cropping systems, it is impossible to be completely rid of soil compaction. However, with minimum tillage and controlled traffic techniques it is possible to control the compaction and to optimise soil condition in the plant lines for crop growth, water infiltration, etc. Other Australian cropping industries are now embracing the concept of the retained bed system – wishing to gain what cotton has already achieved.

How does the cotton system fit with Multifunctionality?

As discussed above, several multiple outputs have eventuated from the improved land management system for Australian cotton. However, the case presented does not appear to represent achievement of multifunctionality.

It is important to note that the land management system for cotton supports the multiple outputs presented here and not *vice versa*. That is, the new land management system drives the multiple outputs. They do not drive the land management system. Additionally, not one of the eleven outputs was planned. Rather, they are serendipitous, ie they are fortunate but they were gained by chance. Very few of the eleven outputs are recognised by people in the cotton industry. They enjoy the time and cost savings of the system, the continued prosperity of their service towns and the increased environmental awareness from CRDC supported training workshops. However, the other outputs are deemed somewhat irrelevant. Supporting this is the lack of data and current studies into most of the eleven points.

The new land management system for cotton production, based on the retained bed system will continue. The reason is that it is well suited to the land where cotton is grown, it is a lower cost and more sustainable system than previously. It is not because there are multiple outputs – attractive and somewhat lucrative as they may be.

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Cultivating our Futures

FAO/Netherlands Conference on
the Multifunctional Character of
Agriculture and Land

12-17 September 1999
Maastricht, The Netherlands

REPORT OF THE CHAIRMAN

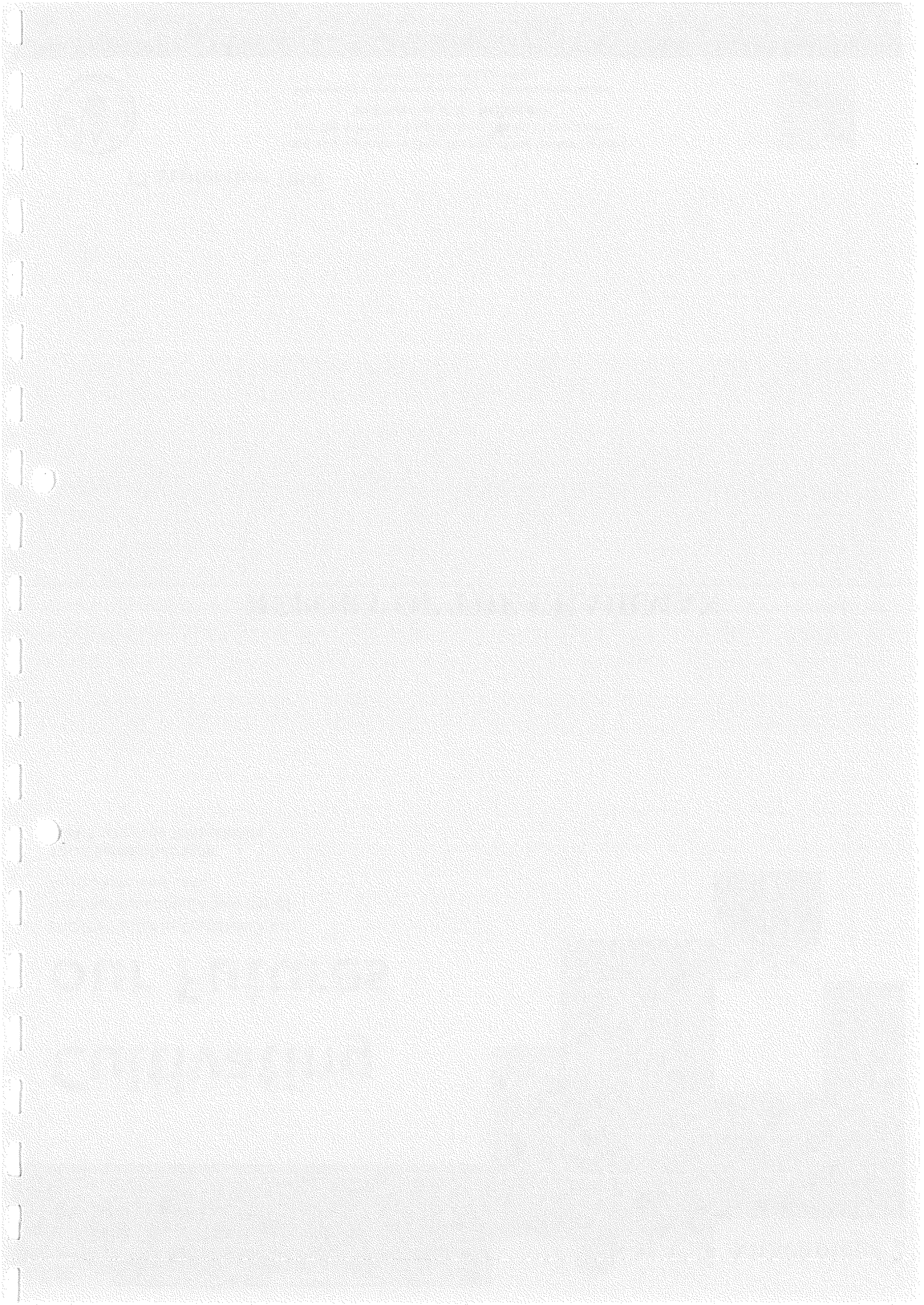
17 September 1999



Food and Agriculture Organization of the United Nations
and the Ministry of Agriculture, Nature Management
and Fisheries of the Netherlands

with the support of the International Fund for Agricultural Development
and other countries and organizations





CHAIRMAN'S REPORT ON

CULTIVATING OUR FUTURES

**FAO/NETHERLANDS CONFERENCE
ON THE MULTIFUNCTIONAL
CHARACTER OF AGRICULTURE AND LAND
Maastricht, The Netherlands, September 12-17th 1999**

**Chaired by Mr. HANS ALDERS, former Minister
of Housing, Spatial Planning and the Environment
of the Netherlands**

1. Background

1. The main challenge of agriculture is to achieve the common objective of food security, at the individual, household, national, regional and global levels and the eradication of poverty. To meet this challenge major adjustments are still needed in agricultural, environmental and economic policies, at national, regional and international levels, to create the conditions for sustainable agriculture and rural development.

1.1 Institutional context of Sustainable Agriculture and Rural Development

2. In adopting Agenda 21 the United Nations Conference on Environment and Development in Rio de Janeiro in 1992 has, amongst other things, set the framework for integrated land management, sustainable agriculture and rural development. Agenda 21 includes many programme areas with a set of objectives, activities and ways and means, often with target dates and specific actions. The first programme area of the 12 programme areas of Chapter 14 (sustainable agriculture and rural development) is described as: "Agricultural policy review, planning and integrated programmes in the light of the multifunctional aspect of agriculture, particularly with regard to food security and sustainable development".
3. At the third session of the Commission on Sustainable Development (1995) it was concluded: "The Commission noted with concern that, even though some progress was reported, disappointment is widely expressed at the slow progress in moving towards sustainable agriculture and rural development in many countries."
4. Given the fact that more than 800 million people remain hungry and in order to achieve the overall goal of food security for all the Rome Declaration on World Food Security and the World Food Summit Plan of Action (1996) have established seven commitments with objectives and actions and commitment by all participants to implement them. Commitment 3 reads: "We will pursue participatory and sustainable food, agriculture, fisheries, forestry and rural development policies and practices in high and low potential areas, which are essential to adequate and reliable food supplies at the household, national, regional and global levels, and combat pests, drought and desertification, considering the multifunctional character of agriculture."
5. The Special Session of the United Nations General Assembly in 1997 concluded that while some progress has been made in implementing the commitments of the United Nations Conference on Environment and Development, much remains to be done. To continue efforts to eradicate poverty, improve food security and provide adequate nutrition the Special Session of the United Nations General Assembly in 1997 asked the formulation of policies promoting sustainable agriculture as well as productivity and profitability, comprehensive rural policies, increase of investments in agricultural research and the continuation of the reform process in conformity with Article 20 of the World Trade Organization-Agreement on Agriculture, as well as the full implementation of the World Trade Organization Decision on Measures Concerning the Possible Negative Effects of the Reform Programme on Least-developed and Net Food-Importing Developing Countries
6. The eighth session of the Commission on Sustainable Development (2000) will deal with the economic sector/major group Agriculture and forests, including the outcome of the Intergovernmental Forum on Forests; the sectoral theme of Integrated planning and management of land resources and the cross-sectoral theme of Financial resources, trade and investment and economic growth. For this purpose a further assessment of the implementation of the goals and targets of Chapters 10 and 14 of Agenda 21 and of the World Food Summit Plan of Action is needed.
7. The principal objectives of the Maastricht conference were:

- To review progress, in the context of agriculture and related land-use, towards the principles contained in the Rio Declaration on Environment and Development and Agenda 21: Programme of Action for Sustainable Development.
- To identify the main issues and tools to be addressed, taking into consideration the continuously evolving nature of agriculture and related land-use.

1.2 Some clarifications on the multifunctional character of agriculture and land

8. All human activities are multifunctional, i.e. they contribute to a varied set of needs and values of society in addition to fulfilling the primary function which is their "raison d' être". So does agriculture, whose "raison d' être" is to provide food and raw materials for society which is the basis for farmers to earn their living. There are no internationally agreed definitions of the multifunctional character of agriculture. However, as shown above, there exist several internationally agreed references to the term. The reasons to consider the multifunctional character of agriculture and related land-use in this Conference are:
- Agriculture and related land-use contribute through several of its functions to fulfilling Agenda 21, Chapters 10 and 14 (sustainable agriculture and rural development and land), which are to be considered at the eighth session of the Commission on Sustainable Development (2000).
 - Agriculture has the capacity to contribute in several ways to welfare. For instance, it is geographically extensive, has a direct impact on nature and the environment and provides the primary food material that ensures humankind subsistence.
 - Recent trends towards a more intensive and specialized form of agriculture have successfully increased our ability to feed the world, but, in some cases, at the expense of social and/or environmental goals. In such cases agricultural policy should strive to achieve a more optimal balance between social, environmental and economic objectives.
 - Nowadays, the growing attention given to the non-food functions of agriculture has augmented the relevance of policies to address the multifunctional character of agriculture and land within the framework of sustainable agriculture and rural development. In developing those policies participants confirmed the importance of targeted, transparent and cost-effective policies which do not distort production and trade. Furthermore, these policies should contribute to food security.

1.3 The wider context of the discussions on Sustainable Agriculture and Rural Development

9. The debate on the progress towards the goal of sustainable agriculture and rural development cannot be isolated from important other international debates and instruments. Since 1992 there have been other developments, resulting in the World Trade Organization-agreements. Commitment to Article 20 of the World Trade Organization's Agreement on Agriculture was reaffirmed at many occasions (third session of the Commission on Sustainable Development in 1995, the World Food Summit in 1996, the Special Session of the United Nations General Assembly in 1997 and the meeting of the Organization for Economic Cooperation and Development Committee for Agriculture at ministerial level in 1998). Further negotiations are mandated within the World Trade Organization-framework. It is also generally acknowledged that policies in one country must not undermine the social, rural, development and environmental objectives in other countries.
10. Furthermore, several of the major environmental conventions, in particular the Convention on Biological Diversity, the United Nations Framework Convention on Climate Change and the Convention on the Combat against Desertification have direct implications for sustainable

agriculture and rural development and strengthen the attention to the environmental impacts, including costs and benefits, and functions of agriculture.

2. Setting of the Conference of Maastricht

11. The Conference of Maastricht constitutes an intersessional event in the Commission on Sustainable Development-process, meant to explore and deepen the understanding and knowledge of sustainable agriculture, rural development and related land-use and to facilitate the decision-making-process in other international fora like the Commission on Sustainable Development and the Food and Agricultural Organization.
In preparation of the Conference the Food and Agricultural Organization produced a Stock-taking Paper, an Issues-Paper and a set of six background-papers on Agricultural Biodiversity; Bioenergy; Drylands; Environment and Trade; Research and technology and Water. These papers as well as the case-studies presented during the Conference were used as background material for the conference. The International Fund for Agricultural Development and the Netherlands took the initiative to organise a preparatory seminar, which was hosted by South-Africa in Johannesburg (July 5-7th, 1999). Invited to the seminar were China, Costa Rica, Egypt, France, Indonesia, Mali, Poland, South-Africa, the United States and the Netherlands as well as the International Fund for Agricultural Development, the Organization for Economic Cooperation and Development, the United Nations Environmental Programme, the World Bank, the International Agri-Food Network, the International Federation of Agricultural Producers and the Popular Coalition.
12. A series of partnership-based Internet activities were initiated to broaden participation during the process leading to the Conference. A two-phased electronic conference launched in February 1999, involved over 1300 people from 80 countries and contributed significantly to the background documentation and directly to the Conference itself. Building on the interest generated during the electronic conference, the WebForum was created to combine electronic conferences (a Virtual Maastricht), on-line documentation, a regularly updated website, daily reports during the conference and photographs and real audio clips from Maastricht.
13. The Conference was attended by about 260 participants from more than 100 countries and 30 organizations. The programme included plenary debates on the technical papers and debates on instruments and policies based on the case studies. Furthermore, one day was devoted to field visits. Over 80 delegates participated in the process as chairpersons and rapporteurs of parallel regional groups and as presenter of case-studies, making the Conference highly participatory. The reports of the parallel regional groups were made available to the Conference.

3. Reviewing the progress

3.1 Furthering the implementation of Sustainable Agriculture and Rural Development

14. The participants reaffirmed their commitment to achieving the ultimate goals and targets for sustainable agriculture and rural development and related land-use and food security as identified in Agenda 21 and in the World Food Summit Plan of Action.
15. The participants agreed that the main problem faced by many developing countries remains poverty and food insecurity, which must be tackled in all possible ways, especially by implementing Agenda 21 and the World Food Summit Plan of Action.
16. The participants, through both individual interventions and regional working groups expressed different perceptions regarding the definition, scope, utility, added value and

coverage of the multifunctional character of agriculture. Participants understood that agriculture has multiple objectives and functions within the framework of sustainable agriculture and rural development which through appropriate policies can all foster sustainable agriculture and rural development and which should be targeted, cost-effective, transparent and do not distort production and trade. A coherent analytical framework needs to be developed for measuring the economic, environmental and social costs and benefits of the interlinkages, taking into account the different circumstances in regions and countries and within countries. This analysis may contribute to a renewed awareness of and reflection on the interlinkages among different aspects of agriculture and could assist in the priority-setting of policies, processes and institutions, synergies and trade-offs involving all stakeholders. The participants also indicated the need to take stock of the lessons learned.

17. The participants agreed that the work done in preparation of the Conference shows that many examples now exist demonstrating successful ways of implementing sustainable agriculture and rural development.
18. Multiple costs and benefits derived from agriculture and related land-use are occurring at a range of scales: from farm to community, to national, to regional and to international levels. The participants stressed that there is a need for continued international cooperation to assist developing countries, in particular the least developed and small island developing countries, provide an adequate enabling environment for the basic requirements for agriculture, especially in the field of access to results of agricultural research and technology. In this respect it was stressed that attention to the opportunities offered by a more explicit and systematic attention to the multiple functions of agriculture and land should not detract from, but could intensify the full implementation of Agenda 21. At the regional level, the participants stressed the need for an intensified cooperation between the regions in the world in achieving sustainable agriculture, especially in the field of institution building, information sharing, technology transfer, capacity building and market access. At the national level appropriate policies in support of food security, land tenure security, land and water conservation and rural development are important elements for sustainability.
19. The participants stressed the need for a fair and market-oriented agricultural trading-system and the avoidance of unjustifiable trade barriers which together with other policies will facilitate the further integration of agricultural and environmental policies so as to make them mutually supportive.
In this perspective they underlined the necessity to make every effort to ensure that policy measures do not unfairly limit market-access nor distort markets for food and agricultural exports. This is especially important for developing countries for their development and implementation of sustainable agricultural policies.
In this respect the participants referred to Earth Summit + 5 (Special Session of the United Nations General Assembly in 1997): "The special and differential treatment for developing countries, especially the least developed countries, and the other commitments of the Uruguay Round of multilateral trade negotiations should be fully implemented to enable those countries to benefit from the international trading system, while conserving the environment. There is a need for continuing the elimination of discriminatory and protectionist practices in international trade relations, which will have the effect of improving access for the export of developing countries."

3.2 Instruments

20. The participants appreciated the case studies presented during the Conference and included in the documents prepared for the Conference as an important contribution to understanding and furthering the progress towards sustainable agriculture and rural development.
21. The participants identified the following conclusions: