Adoption of Conservation Cropping in Dryland Regions of Iraq and Syria

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Middle East cropping systems
Crop adaptation – breeding & management
ACIAR project background
Project impact - adoption
Three pivotal strategies:
1. Adaptive R&D
2. Low cost zero-tillage seeders
3. Participatory extension
Challenges for CA in Middle East
Chinese Proverb

"He who asks, is a fool for five minutes, but he who does not ask, is a fool for ever."

So please ask.
**Middle East Dryland Cropping Systems**

**Environment**
- hot dry summer & cool wet winter
- low & variable rainfall
- infertile soils
- dust storms common
- soil erosion

**Crop Management**
- cereal:fallow rotation
- heavy cultivation (2-3)
- stubbles grazed/burnt
- basic seeding methods
- late sowing (Dec-Jan)

**Production**
- wheat <1t/ha
Australia 1970 - 2010

- eliminated fallow
- introduced grain legumes and canola
- use of herbicides and early sowing
- adoption of zero-tillage with the retention of stubble
- Consolidation of farms - big fields and big “toys”
% Australian farmers using no-till/zero-till in 2008
(after Llewellyn and D’Emden, 2010)

77-94% (88%)  
n=6

55-85% (76%)  
n=5

45-89% (78%)  
n=4

68-81% (75%)  
n=3

72% n=1
Environmental Constraints

Typical Mediterranean-type environments experience:

- Cool wet winters and hot dry summers.
- Rainfall: 1,000 to 250 mm p.a.
- Radiation: not a major limitation
- Crop growth during summer not possible without irrigation
- Early flowering is limited by winter cold temperatures in some areas.

Aleppo Syria 36°11’N, 37°13’E
Crops traditionally are planted in December, after first rains and cultivation. Transpiration exceeds rainfall in spring. Crops run into terminal drought in May/June. Maturity in June or July.
Breeding for Dry Areas

In dry areas where cold is not a major limitation, breeders select for:
- early vigour,
- early anthesis (A), and
- early maturity.

Hence, modern varieties avoid drought conditions in late/spring and summer.
Breeding for Dry Areas

Early anthesis allows a longer period of grain growth when rainfall and temperatures more favourable. Hence, early maturity crops avoid terminal drought.
In many countries, knockdown herbicides and “direct drilling” was adopted during 1970-80’s which enabled early sowing. This reduced soil evaporation and increased vegetative growth during the favourable winter period, and grain filling under cooler spring conditions. In Australian wheat yields were increased by 15 – 35 kg for every day sowing was advanced (or up to 250 kg/week).
ACIAR CA Project - Target Region

Iraq
1.8 mill ha wheat
1.4 mill ha barley
Imports 4 mill tonnes

Ninevah
20% of wheat
32% barley
ACIAR CA Project - Three Phases

First Phase (2005-08) - improve dryland cropping in northern Iraq (Ninevah) through the testing, promotion and dissemination of improved crop cultivars and crop management practices.

Second Phase (2008-12) - To increase crop productivity, profitability and sustainability in the drylands of Ninevah through the development, evaluation and promotion of conservation cropping technologies involving zero-tillage, stubble mulching, improved crop cultivars and better crop management.

Third Phase (2012/15) – Continue conservation cropping extension, research, socio-economic studies, seed production and training in Ninevah, and expand into the new governorates of Salahadain, Kirkuk and Anbar (and Erbil).
Phase 3 Objectives

1. ‘best-bet’ variety and conservation cropping demonstration and extension

2. conservation cropping and variety research

3. seed production

4. socio-economic studies of adoption and impact

5. training and capacity development
Good start in developing and promoting zero tillage in Iraq & Syria

70-80% of area was true adoption, where farmers owned/rented/borrowed a ZT seeder.
Three pivotal strategies were:

1. Focus on adaptive research and development

2. Availability of low cost zero-tillage seeders

3. Participatory extension – farmer testing
Strategy 1: Tillage R & D

Crop x tillage x time of sowing x year (06/07 – 11/12)

Overall:
- ZT ≥ CC
- early ≥ late planting

Grain yield (kg/ha)
Strategy 1: Tillage R & D

Summary of outcomes:

- ZT productive, profitable & sustainable
- Early sowing most productive
- No need for special ZT varieties
- Reduced seed rates most profitable
- Stubble retention less important than ZT
- Identified improved varieties for Iraq
- New crops for Iraq (peas, oats, canola)

Gave researchers and farmers confidence to include these in large scale demonstrations.
stop plowing
if needed, kill weeds at sowing with glyphosate
plant early (November)
use ZT seeders for all crops
use good quality seed of best adapted varieties
reduce seed rates; 50-100kg/ha cereals; 100-150kg/ha pulses
sow consistently at optimum depth (4-6cm)
use best fertility & weed/disease/pest management
include non-cereals in rotation if possible
keep stubble if possible - don’t burn
graze stubble if needed - doesn’t cancel ZT benefits
“Conservation Cropping” Package

GREATER LONG TERM PROFITS

Increased yield
Early/timely sowing
Improved soil fertility
Decreased erosion
Less greenhouse gas

CONSERVATION AGRICULTURE

CONSERVATION
AGRICULTURE

Zero Tillage

Soil Cover

Diverse Rotations

+ early sowing
“Conservation Cropping” Package

GREATER LONG TERM PROFITS

- Increased yield
- Early/timely sowing
- Improved soil fertility
- Decreased labor cost
- Decreased fuel cost
- Decreased erosion
- Less greenhouse gas
- Greater Long Term Profits

CONSERVATION AGRICULTURE

- Soil Cover
- Zero Tillage & Early Sowing
- Diverse Rotations
Many development projects relied on imported zero-tillage (ZT) seeders from European or South American manufacturers - big, heavy, & expensive.

Imported ZT Indian seeders – light & fragile

Can we do better locally? Can we modify existing seeders? Can we make our own?
Strategy 2: Low cost ZT seeders

Dr Jacky Desbiolles
Uni of South Australia

Seeder training Erbil 2013
Seven Syrian village manufacturers: 2008-12: made/sold >100 seeders

 Seeder features: all spring tines, wide-spaced rows, narrow points, seed/fertilizer delivery, 2 - 4m wide, 3PL or trailed, low cost ≈ $2000-6000.
Strategy 2: Low cost ZT seeders

Fabrication of ZT modification kits in Iraq 2010-11.

18 Iraq farmers
Modification cost: $1200

First prototype seeder completed in Dec 2012.
Strategy 2: Low cost ZT seeders

• 104 zero-tillage seeders in Syria + 50 more in 2013
• In excess of 50 seeders in Iraq.
Strategy 3: Participatory Extension

- ACIAR-ICARDA Iraq Project
- NARES
  - Research Commission (GCSAR)
  - Directorate of Extension
  - Aleppo University
- NGO
  - Aga Khan Foundation
- Private sector
  - farmers
  - seeder manufacturers
  - Syrian Libyan Company (SYLICO)
  - private consultants

Stakeholder meeting
6 August 2009
Strategy 3: Participatory Extension

Syrian Farmer Groups 11/12

Rainfall in mm

- Extension Unit
- 0  - 200
- 200  - 250
- 250  - 350
- 350  - 600
- 600 or more
Strategy 3: Participatory Extension

All stakeholders involved in all stages – planning, planting, field walks/training, field days and harvest.
Strategy 3: Participatory Extension

Locations
High Rainfall (>450mm)
Al Shikhan
Rabeea
Al Qush

Moderate Rainfall (200-400mm)
Al Hamdania
Tel Kief
Baashiqa

Low Rainfall (<200mm)
Tel Abta
Al Hatra
Al Mahalabya

Supp Irrigation:
Rabeea (HRA)
Al Nimrud (MRA)
Hummaidat (LRA)

Demonstrations in Ninevah 12-28 sites p.a.
Strategy 3: Participatory Extension

Iraqi Extension Groups
### Estimated Returns for ZT & Early Sowing

<table>
<thead>
<tr>
<th>Operation</th>
<th>Change</th>
<th>Return or saving ($/ha)</th>
<th>Iraq</th>
<th>Syria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use ZT &amp; sow early</td>
<td>+500 kg/ha wheat</td>
<td>350</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>Stop plowing</td>
<td>2 → 0 times</td>
<td>50</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Reduce seed rate</td>
<td>300 → 100 kg/ha</td>
<td>140</td>
<td>80</td>
<td></td>
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<tr>
<td>Herbicide applicatn</td>
<td>extra glyphosate</td>
<td>-15</td>
<td>-15</td>
<td></td>
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<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>525</strong></td>
<td><strong>315</strong></td>
<td></td>
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<tr>
<td>Adoption in 2011/12</td>
<td></td>
<td>7,800 ha</td>
<td>30,000 ha</td>
<td></td>
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<tr>
<td>Net economic benefit</td>
<td></td>
<td>US$ 4.0 mill</td>
<td>US$ 9.4 mill</td>
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If 50% of Iraqi wheat and barley switched to CA, net benefit of $800 million. Financial incentives drive adoption by farmers.
Ongoing Challenges

+ early sowing

Minimum Tillage

CONSERVATION
AGRICULTURE

Soil Cover

Diverse Rotations
Ongoing Challenges – Soil Cover

Soil cover – maintaining stubbles – grazing management

Use of forage crops/alternative feeds

Novel production systems – alley cropping

How valuable is stubble for stock vs soil?
Mono-cropping is not sustainable.

Diverse rotations – forages, grain legume & other crops
Government policies:
- wheat subsidies discourage other crops
- land tenure & inheritance – economy of scale
- subsidies for zero-till seeders

Security – project leader unable to travel to many areas
- limited travel for national staff & farmers
- fuel supplies/cost in Syria
- poor internet
Ongoing Challenges – Military Tillage!
ICARDA CA Projects (on-going & pipeline)
The Most Important Element: People

Dedicated and industrious partners from Iraq, Syria and Australia:

- researchers
- extension officers
- seeder manufacturers
- NGOs (Aga Khan Foundation)
- farmers
Some of Those People...

Dr Colin Piggin (with Mahmoud Solh)

Mr Atef Haddad with Syrian manufacturer

Dr Abdul Sattar (Uni Mosul)

Mr Sinan Jailili (Iraq farmer)
Conservation and the Qur’an

And the servants of the Most Merciful are those who walk upon the earth gently, and when the ignorant address them [harshly], they say [words of] peace, (25:63)