What do We Know About the Information Needs of Farmers and the Challenges to Meeting those Needs?

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Presentation

• Introduction

• Agriculture Sector in Africa and South Asia

• Information Needs of Farmers

• How the Information Needs can be met?

• Challenges in the Provision of Information

• Conclusions
Global Population

• 12,000 years ago : 10 million

• From the beginning of the Christian era to the eighteenth century : First billion

• Next 100 years : Second billion

• During 30 years (1961-63 to 1990-92) : 2.1 to 4.1 billions

• Current population : 7.05 billions

• Projected population by 2050 : 9.3 billions
Agricultural projections by 2050

- Projected population of 9.3 billion (34% higher than today, 70% urban, 49% today)

- Agricultural production must increase by 70% (≈ 100% in developing countries)

- One additional billion tonnes of cereals and 200 million tonnes of meat to be produced annually by 2050 (as compared with production in 2005/07)

- 90% (80% in developing countries) of the growth in crop production would be a result of higher yields and increased cropping intensity, with the remainder coming from land expansion

- Arable land would expand by some 70 million ha (< 5%), the expansion of land in developing countries by about 120 million ha (= 12%) being offset by a decline of some 50 million ha (= 8%) in the developed countries.
The Challenge: Food Demand

Global food production must increase by at least 70% and possibly be doubled by 2050.

Source: UN Environment Program Estimates, 2010
The Challenge: Highest Child Malnourishment Rates in South Asia and Sub-Saharan Africa

1990-92 Total=1000 million

2010-12 Total=868 million

Data Source: The State of Food Insecurity in the World 2012
The Challenge: Projected Climate Change impacts highest in SSA and South Asia (2003-2080)

Productivity of most crops to decrease marginally by 2020, and by 10-40% by 2070.

Increased droughts, floods and heat waves: (+/-) production variability

Length of growing period in rainfed areas is likely to reduce

Source: Cline (2007)
The Challenge: Annual loss of per capita arable land is highest in Sub-Saharan Africa and South Asia, 1961–2009

Source: IFPRI, 2011
The Challenge: Water

• Agriculture consumes 70% of all water withdrawn from rivers and aquifers globally.

• The average European diet requires about 3,500 litres of water each day – 2.5 litres for drinking, 150 litres for cooking, cleaning and washing, and the rest for producing food.

• In South Asia and sub-Saharan Africa, millions of people must survive on less than 1,000 litres per day.
Based on the key elements of food security as laid out by FAO, it’s calculated using 12 indicators, measuring the availability, access and stability of food supplies across all countries, as well as the nutritional and health status of populations.
Operational holdings are declining (Data from India)

<table>
<thead>
<tr>
<th>Farm size</th>
<th>Number of holdings (million)</th>
<th>% share of total holdings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marginal (&lt;1ha)</td>
<td>36.2</td>
<td>92.2</td>
</tr>
<tr>
<td>Small (1-2 ha)</td>
<td>13.4</td>
<td>26.9</td>
</tr>
<tr>
<td>Medium (2-4 ha)</td>
<td>10.7</td>
<td>17.5</td>
</tr>
<tr>
<td>Large (&gt;4ha)</td>
<td>10.7</td>
<td>7.8</td>
</tr>
<tr>
<td>All</td>
<td>71.0</td>
<td>144.4</td>
</tr>
</tbody>
</table>
Information Needs of Small Farmers is a Greater Priority

- Smallholders (less than 2 ha), include small (1-2 ha), 19%; marginal (< 1 ha) and sub-marginal (<0.5 ha), 64%; 83% of all farming households;

- In world 2 billion smallholders (out of >6 billion people) of which about 600 million i.e. 30% in India;

- Poverty largely a rural phenomenon, and marginal farmers along with landless labourers, pastoralists, tribal farmers, comprise the bulk of the rural poor and hungry
The distribution of poor livestock keepers
• 1% of the total area receives 600 - 800 mm annual rainfall – supports crop and livestock production

• 10% of the total area receives annual rainfall of 300 - 600 mm which can support agro-pastoralism.

• 12% of the total area receives annual rainfall of 150 - 300 mm which can only support pastoralism.

• Over 77% of the total area receives annual rainfall of less than 150 mm which can support only irrigated crops and nomadic pastoralism.

Over 75% of the population lives in the sudano-sahelian and sahelian zones
How can we assist farmers

There is an urgent need for a transition from chemical- and machinery-intensive to knowledge- and labor-intensive farming technologies.

Dr M.S. Swaminathan

Use the knowledge and findings of science and translate them into useful products of relevance to the end users (specially resource poor farmers and consumers)

Sir Gordon Conway
Knowledge to assist Small Farmers

• Agriculture is becoming knowledge intensive. Knowledge is often a substitute for land and water, since it helps farmers to produce more from the same plot of land and same quantity of water.

• Frontier technologies such as Agricultural Meteorology, Information and Communication Technologies, Simulation Modelling and Remote Sensing Applications provide unique opportunities for providing services to Farmers.

• In order to ensure social inclusion in access to new technologies, public investment in socially relevant agricultural research should be stepped up.

• Improved interactions with user communities including private sector institutions and NGOs are essential.
Information Needs of Farmers

• Information based on assessment of natural resources for strategic long term development planning or crop diversification.

• Information based on monitoring variations in crop growth and development during the growing season to facilitate tactical operational decisions.

• Information based on seasonal to interannual climate forecasts to help counter climate-induced variability and help agriculture adapt to changing climate.
Information for Strategic Planning

• This activity is mainly concerned with the evaluation of natural resources in agronomically relevant terms on a regional and national scale.

• Traditionally, climatologists have relied heavily on monthly and annual means of climatic elements.

• To understand variability of climatic elements and develop applications, it is important to place emphasis on long term daily data.
Information for Strategic Planning - Examples

- Rainfall probabilities
- Onset and ending of rains, length of the growing season
- Drought frequencies and probabilities
- Temperature probabilities
- Simple water balance
- Agroecological zonation
- Crop modelling
- Climate Scenarios
Rainfall Analysis

• Quantification of the variability at the annual, monthly, and daily time scales.

• Characteristics of daily rainfall to understand its critical nature between locations.

• Studies of spatial variability of rainfall using geostatistics.

• Studies on region-specific features such as persistency, geographical patterns of variability.
Meeting the Information Needs through Historical Rainfall Analysis

• Analyse historical daily rainfall data for indicators to forecast the seasonal rainfall.

• Use the forecast to guide the management decisions.

(Stewart, 1985; Sivakumar, 1987)
Example for West Africa

When do the rains begin?

Date after 1 May when rainfall accumulated over three consecutive days is at least 20 mm and when no dry spell within the next 30 days exceeds 7 days (X).

When do the rains end?

Date after 1 September following which no rain occurs over a period of 20 days (Y).

What is the length of the growing season?

The difference (Y-X)
When Rains Start Early, the Growing Season is Longer

Niamey, Niger

Growing season length (days)

Julian day of onset of rains
What are the probabilities for growing season lengths of varying durations for a given date of onset of rains?
Probabilities of growing season length exceeding specified durations for variable onset of rains for Niamey, Niger

<table>
<thead>
<tr>
<th>Date of onset of rains</th>
<th>Length of growing season (days) exceeding</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>75</td>
</tr>
<tr>
<td>24 May</td>
<td>100</td>
</tr>
<tr>
<td>2 June</td>
<td>100</td>
</tr>
<tr>
<td>12 June</td>
<td>99</td>
</tr>
<tr>
<td>22 June</td>
<td>87</td>
</tr>
<tr>
<td>2 July</td>
<td>48</td>
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Empirical analysis of dry spells for agricultural applications

• When are droughts most likely to occur during the growing season?
• What is the expected length of droughts?
The specific definition of onset of rains in each year could be used as the sowing date and the length of dry spells (or days until the next day with rainfall greater than a threshold value) can be computed at different probability

Sivakumar (1991)
When do the Droughts Occur more frequently in the Sahel?

![Graph showing days after sowing vs. days until next rain > 10 mm for Ouagadougou, Hombori, and Niamey.]
Meeting Information Needs through A New Paradigm

- The “Food First” focus in the past focussed primarily on “vertical relationship”.

- Present task of conserving and enhancing natural resources is more complex.

- Presence of several systems in the landscape calls for "horizontal analyses".
Horizontal analyses - What is required?

- Integration of biological, physical and socio-economic factors in a holistic manner.

- Geographic Information Systems (GIS) and other spatial modelling techniques make this possible.

- Use of Agro-ecological Zones (AEZ) approach.
Information for Tactical Planning

• The wealth of meteorological information available on real time basis could be used for on-farm operational decisions.

• Such tactical decision making is based on a sound knowledge of weather variations on crop growth and yield.

• Availability of high speed computers makes it feasible to provide easy access to this information.

• Tactical studies could address a variety of issues at different scales ranging from whole regions to individual fields.
Weather-Responsive Crop Management Tactics

Combine the knowledge of historical weather data analyses with the real time weather information to make changes in the crop management tactics, eg.,

- Land preparation and cultivar Selection
- Choosing windows for sowing/harvesting operations
- Irrigation scheduling
- Mitigation from adverse weather events -frost, low temperature, heavy rainfall – at critical crop stages
- Nutrient Management : Fertilizer application
- Plant Protection: Pesticide spraying schedules
- Feed, Health and Shelter Management for Livestock [Optimal temperature for dairy/ hatchery etc]
Forecasting Pest and Disease Incidence

• Pests, diseases and weeds are the major biotic factors affecting crop production.

• Until recently, the major mode of control of pests and diseases was through the use of pesticides and fungicides.

• Heavy use of pesticides is damaging to environment and is unsustainable in the long run.

• Hence major investments are being made in Integrated Pest Management (IPM) strategies.
Forecasting Pest and Disease Incidence (2)

• Of late, there is increased interest in the applications linking climate and pest and disease modelling.

• It underlines the importance of gaining a better understanding of the interrelationships between the physical and biological environments of pests, diseases and their hosts.

• Minimum data sets should be collected over several years to quantify the major factors required for models of agroecosystems that are essential for designing pest management programs.
One of the persistent demands from the agriculturists is to have reliable forecasts of seasonal weather patterns as it could help them take appropriate decisions.

Quantitative forecasts of the amount and temporal distribution of rainfall during the growing season is difficult to forecast.

Meteorologists have approached the problem of long-range forecasts based on the assumption that if the precursors and effects of large-scale changes were understood, they could serve as rough guides to meteorological future.
El Niño-Southern Oscillation (ENSO)

• The most prominent, promising and well defined pattern of interannual variability is the El Niño-Southern Oscillation (ENSO).

• El Niño episodes typically start around March-April and last around twelve months. If the SOI is strongly negative around June-July, then an El Niño has usually commenced and will last into the following year.

• Monitoring the SOI can provide drought predictions, given our current state of knowledge.
Challenges to Meeting Information Needs

• Critical Need to Improve Observations and Monitoring

• Improved investment in Research, Modelling and Prediction

• Improving Climate Services Information Systems

• Structuring Information for Better Use by the Farming Community

• Capacity Building
Rainfall stations’ density: from 0 to about 8 stations per 1000 km² (8 times lower than WMO minimum requirements)

Synoptic stations’ density: from 0 to 1 station per 1000 km²
Research and Modelling Efforts to Improve Natural Resource Management by Farmers

- Farm management (e.g. planting, irrigation, fertilization and harvest scheduling)
- Resource management (e.g. several Govt. agencies and private comp. use)
- Climate change and policy analysis
- Production forecasts (e.g. global, regional and local forecasts)
- Research and development (e.g. research priorities and guide fund allocations)
- Turning information into knowledge (e.g. information overflow in every area including agricultural research)
Improving Climate Services Information System

• Need to strengthen current data bases, increasing climate knowledge and improved prediction capabilities

• Early assumptions about the value of climate forecasts were often exaggerated due to a lack of understanding of the variety of user-decision making environments.

• Users are diverse and can not be lumped into a homogeneous set.

  - Subsistence farmers  - self sufficiency or survival
  - Commercial farmers  - profit maximization

• Important to assess the degree of flexibility with which the different groups operate in the application of climate forecasts.
Structuring Information for Better Use by the Farming Community

• Information needs to be downscaled and interpreted locally.

• Information must express accuracy in transparent, probabilistic terms.

• Information must be interpreted in terms of agricultural impacts and management implications.

• Expand rural connectivity through appropriate measures eg, connecting key locations with fibre optic network, using wireless technology and operating information kiosks through a partnership of citizens, civil society organizations, private sector and Government.
Percentage of the world's population covered by a mobile cellular signal

2003
- 39% not covered
- 61% covered

2010
- 10% not covered
- 90% covered

Source: ITU World Telecommunication /ICT Indicators

Dakar Workshop 2012
Capacity Building

- Undertake training activities to make farmers become more self-reliant in dealing with weather and climate issues that affect agricultural production on their farms.

- Secure farmer self reliance, through helping them better informed about effective weather and climate risk management by sustainable use of natural resources for agricultural production.
Roving Seminars on Weather, Climate and Farmers in Africa
Global Framework for Climate Services

- **Goal:**
  - Enable better management of the risks of climate variability and change and adaptation to climate change at all levels, through development and incorporation of science-based climate information and prediction into planning, policy and practice.
The vision of the GFCS

Users, Government, private sector, research, agriculture, water, health, construction, disaster reduction, environment, tourism, transport, etc
‘Recall the face of the poorest and weakest man whom you have seen, and ask yourself, if the steps you contemplate are going to be of any use to him. Will he gain anything by it? Will it restore to him control over his own life and destiny?’

M. K. Gandhi