APPLICATION OF FUTURE REMOTE SENSING SYSTEMS TO IRRIGATION

LEE D. MILLER
NEBRASKA REMOTE SENSING CENTER

GENERAL AREAS OF DISCUSSION

I. PUBLIC MANAGEMENT OF AGRICULTURAL WATER SUPPLY/DEMAND

OBJECTIVE: MODEL WATER CONSUMPTION

SHORT RANGE USE OF INFORMATION:
- PROPORTIONING OF AVAILABLE WATER
- CROP MANAGEMENT - WHAT TO PLANT

LONG RANGE USE OF INFORMATION
- CONSUMPTION PERMITS
- STATE AND FEDERAL STATUTES
- INTERBASIN TRANSFERS
- GROUND WATER RECHARGE

REQUIRES: AREA ESTIMATES OF IRRIGATED CROPS
currently good in dryland areas and marginal in mixed irrigated/nonirrigated ares of same crops
CROP TYPE

USER: FEDERAL AND STATE AGENCIES ... WATER DISTRICTS

II. IRRIGATION SCHEDULING FOR DISTRIBUTED MANAGEMENT OF YIELDS

OBJECTIVES
BACKGROUND
INFORMATION NEEDS FROM REMOTE SENSING ON A SPATIAL BASIS
INFORMATION / DATA DISTRIBUTION
ON SITE DATA PROCESSING
MODELING FOR DECISIONS
ACCEPTANCE / USE OF RESULTS

see attached pages

USER: IDIVIDUAL FARMER, RANCHER, AGRICULTURAL CONSULTANT

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IRRIGATION SCHEDULING FOR DISTRIBUTED MANAGEMENT OF CROP YIELDS (BY FARMER/RANCHER)

OBJECTIVES:

1. MANAGEMENT OF WATER APPLICATION FOR OPTIMAL YIELDS.
2. ENERGY MANAGEMENT FOR OPTIMAL YIELDS.
3. NUTRIENT APPLICATION FOR OPTIMAL YIELDS.

BACKGROUND STATEMENT:

INDEPENDENT OF REMOTE SENSING IRRIGATORS ARE DEVELOPING THE METHODOLOGY FOR THE SPATIAL CONTROL OF THE APPLICATION OF WATER TO INDIVIDUAL FIELDS TO ACHIEVE THE ABOVE OBJECTIVES.

CURRENT ACTIVIES RANGE FROM:

- LAND LEVELING — *to control application rates in surface flooding*
- CENTER PIVOTS — *has potential for "in field" variable application of water and chemical via microprocessor control**
- TRICKLE SYSTEMS — *direct spatial control of water and chemical applications almost to level of single plant*

MANY OTHER INTERMEDIATE TECHNIQUES EMPLOYED AND UNDER DEVELOPMENT FOR THE CONTROLLED SPATIAL APPLICATION OF IRRIGATION WATER WITH LITTLE OR NO INPUT FROM REMOTE SENSING COMMUNITY. WITH A LITTLE EFFORT ON OUR PART THIS COULD BE A VERY SYMBIOTIC RELATIONSHIP.

**such a system might even have its own remote sensors on board.*

INFORMATION NEEDS FROM REMOTE SENSING ON A SPATIAL BASIS

BASED PRIMARILY ON WHAT MIGHT BE FEASIBLE WITH OPTICAL REMOTE SENSORS

1. CANOPY PHYSIOLOGY -- LEAF WATER CONTENT
   GREEN BIOMASS - *(functioning versus non-functioning)*
   BROWN BIOMASS
   LEAF SURFACE AREA *(not equal LAI)*
   GEOMETRY *(e.g. for wilt status)*
   CANOPY TEMPERATURE
2. SOIL WATER STATUS -- SURFACE
   SUBSURFACE *(non-optical sensors)*

ALL THE ABOVE ARE POTENTIALLY AVAILABLE FROM REMOTE SENSORS AND THE REAL QUESTIONS TO BE ADDRESSED INCLUDE:

1. TIMING?
   - HOW TO ACHIEVE DATA FREQUENCY REQUIRED *(e.g. off axis pointing)*
   - TIME OF DAY
   - NEED FOR INSTANTANEOUS MEASUREMENTS
   - NEED FOR INTEGRATED MEASUREMENTS *(e.g. HCMM idea)*
   - SCHEDULING COVERAGE *(widely distributed spatial demands)*
2. SPATIAL RESOLUTION?
   - HIGH RESOLUTION AND POINTABLE INTO IRRIGATED AREAS*
3. ACCURACY?
   - RADIOMETRIC
   - GEOMETRY AND GEOENCODING
4. INFO/DATA DISTRIBUTION? *(see seperate sheet)*

**as a group IRRIGATED CROP LANDS are the most intensively managed agricultural lands requiring remote sensing inputs while providing maximum yield and return per acre. they are however grouped into areas of concentration toward which a sensor could be pointed.*

INFORMATION / DATA DISTRIBUTION

GOALS:

1. OVERNIGHT — *near real time direct video broadcast (e.g. daytime data delayed for broadcast during low use night periods.*
2. NO CENTRAL STORAGE — *digital data encoded into video, transmitted and then decoded back to digital on site.*
3. ON SITE CAPTURE — *capture on video recorder as analog.*
4. LOW COST — *orient whole process toward consumer products: antennas, recorders, displays, processors, ...*

REQUIRES RESULTS OF FUTURE WORK WITH MODELS, ETC. TO DETERMINE HOW MUCH PROCESSING FROM "DATA" TO "INFORMATION" IS PERFORMED AT A CENTRAL SITE BEFORE DISTRIBUTION

? DISTRIBUTE INFORMATION SUCH AS SPATIAL VARIATION IN LEAF WATER CONTENT, GREEN BIOMASS, ETC.

BECAUSE:
1. MODEL REQUIRES COMPLICATED TUNING
2. MODEL REQUIRES COMPUTING POWER NOT AVAILABLE ON SITE

? DISTRIBUTE DATA SUCH AS "CLEAN" MULTISPECTRAL IMAGES WITH SYSTEMATIC, GEOMETRIC, AND OTHER IMAGE RELATED ADJUSTMENTS

BECAUSE:
1. FARM MANAGEMENT MODEL REQUIRES LOCAL ON SITE INPUTS *(see section on modeling*
2. SOME IMAGE CORRECTIONS REQUIRE LOCAL OBSERVATIONS FROM USER *(solar incoming, atmospheric observations, etc.)*

ON SITE DATA PROCESSING

CLOSELY CONTROLLED BY DISTRIBUTION AND MODELING REQUIREMENTS

NOT CLOSELY CONTROLLED BY SPATIAL RESOLUTION AND OTHER PRIME CONSIDERATIONS OF OUR CURRENT EXPERIENCES WITH CENTRALIZED SYSTEMS

CONSIDERATIONS AND COMMENTS:

HARDWARE *not limiting now or in the future!*

1. ALL OBJECTIVES CAN BE MET TODAY FOR TODAYS DATAT/INFO/MODELS FOR TODAYS IMAGES IF THEY WERE AVAILABLE TO FARMER/RANCHER
2. THERE IS EXTENSIVE USE OF SUITABLE MICROPROCESSORS AND OTHER RELATED DATA CAPTURE AND DISPLAY DEVICES ON THE FARM TODAY

SOFTWARE

DATA FORMATS

LOW COST HARWARE DEVELOPMENTS IN COMERCIAL PRODUCTS AREA OF DIRECT IMPACT

IN NEXT 3 YEARS: *should begin experimentation with use immediately*

1. *a faster processor will be available on the farm with 16bit words and 1megabyte of memory (Radio Schack, Apple IV, Sage, Fortune, ...)*
2. *200megabyte, low cost, optical read/write disk (i.e capacity for 6 MSS images) with a size and price related to current floppy disks (Sharp Electronics)*
3. *Digital recording still cameras with film playback units (Sony Mavika)*

IN NEXT 3 TO 10 YEARS: *the actual time framework of any new land oriented R.S. system*

1. *a 32bit micromainframe on a desk*
2. *flat, large screen, high resplution, digital image displays*
3. *1000 gigabytes of low cost, read write storage on digital optical disks*

MODELING FOR DECISIONS

TO BE EXECUTED ON SITE ON THE SPECIFIC FIELD ON A SPATIAL BASIS

SHOULD RUN AT ALL LEVELS OF COMPLEXITY; I.E. SHOULD RUN WITH ONLY REMOTE SENSING INPUTS BUT ALSO WITH INCREASING LEVEL OF COMPLEXITY AND ACCURACY WITH INCREASING INPUT OF FARMER COLLECTED, ON SITE INFORMATION

CURRENT MODELS TESTED IN REMOTE SENSING CONTEXT TAKE LITTLE ACCOUNT OF EXTENSIVE INFORMATION AVAILABLE FOR INPUT OF FARMER ON SITE!

WHEN WE REORIENT OUR APPROACH TO RUN ON SITE THE FOLLOWING NEW AND VERY SIGNIFICANT INPUTS ARE AVAILABLE FOR EACH FIELD:

SPATIAL VARIATION IN FIELD OF:

- SOIL TYPE AND PROPERTIES
- TOPOGRAPHY
- TREATMENTS/ EARLIER APPLICATIONS OF WATER
  - CHEMICALS
  - MECHANICAL

MANAGEMENT PRACTICES OF:

- CROP TYPE
- CHEMICAL APPLICATIONS
- CROP CALENDAR/ PLANTING DATE AND METHOD
  - GROWTH STAGE VS. TIME

POINT MEASUREMENTS VS. TIME OF ENVIRONMENT:

- ON SITE PRECIPITATION
- AIR TEMPERATURE
- HUMIDITY
- E.T. ESTIMATES
- WIND SPEED

ACCEPTANCE / USE OF RESULTS

1. CAN BE ACCOMPLISHED WITH A MINIMUM OF EFFORT - ECONOMIC INCENTIVES ALREADY EXIST
2. EQUIPMENT REQUIRED ALREADY BECOMING AVAILABLE ON SITE FOR OTHER RELATED REASONS
3. USE EXISTING EXISTING EDUCATIONAL/DISTRIBUTION CHANNELS TO FARMER/RANCHER VIA EXTENSION AGENT, AGRICULTURAL CONSULTANTS, CO-OPS, ETC.