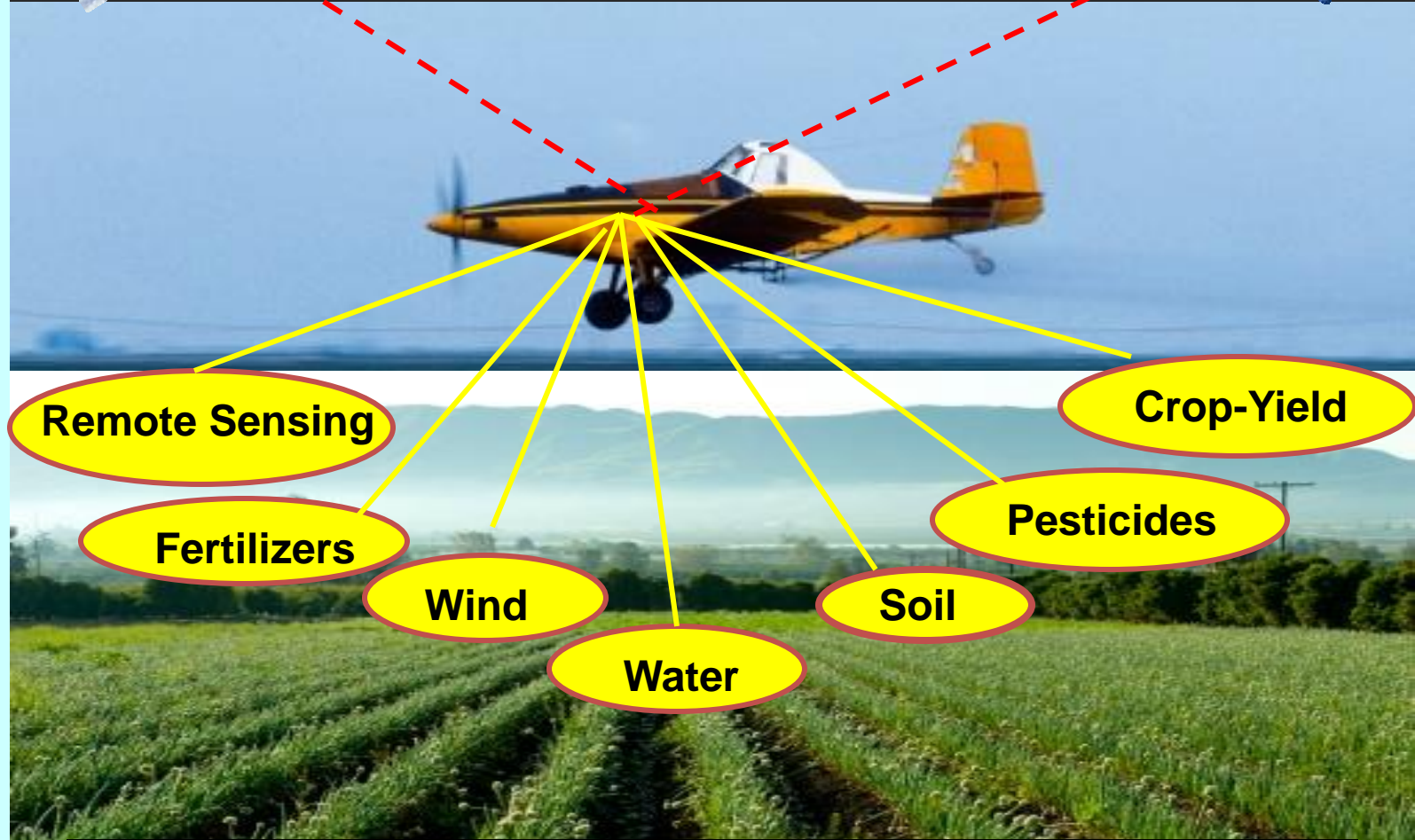


Precision Agriculture & Global Navigation Satellite Systems



Its Relevance to India

Dr. C B Jagannatha Rao DSc.Agri. (Tokyo)

EU-GNSS ASIA-INDIA

In Grateful acknowledgement to

**European Business Group-India
Bangalore Chapter**

**for the Kind Invitation to speak
at this Experts Workshop**

INDIA

Vs.

EUROPEAN-UNION

Population= 1.2 Billion
75% -living in rural areas &
still dependent on
Agriculture.

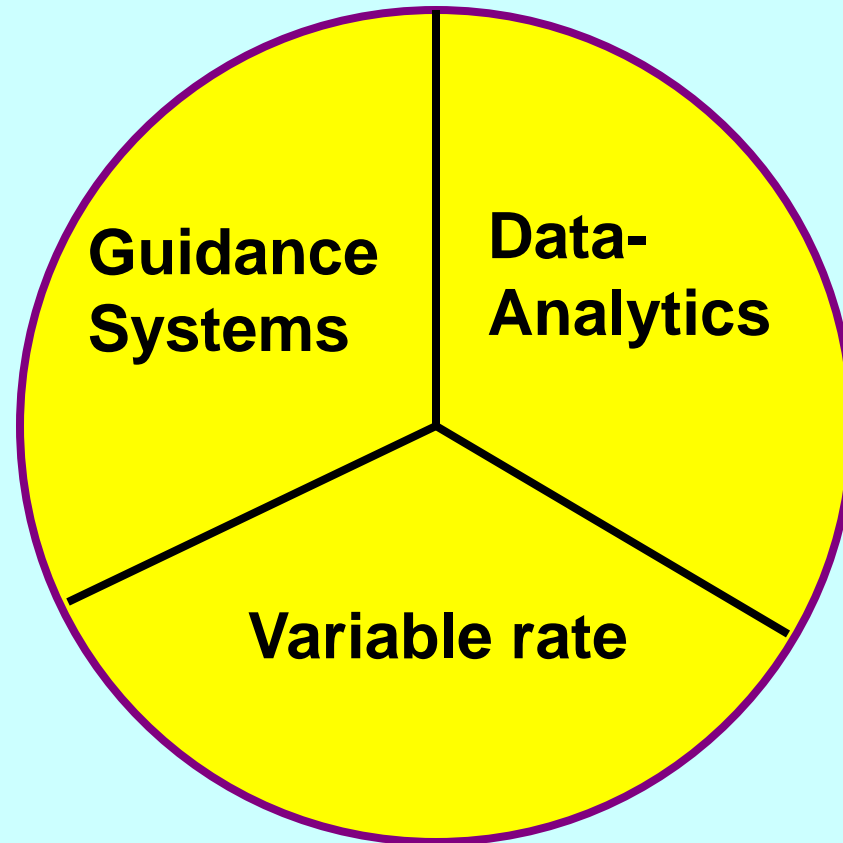
Aprox.43% of India's geog.
area used In agriculture

Total Geog. Area 329 M.H
Net Sown Area (45%) 143 M.H
Net Irrigated Area 56 M.H
65% dependent on
Agriculture;

Agriculture = 27% of GDP
Policy makers & beneficiaries
are at opposite ends of
spectrum; Requirements of
Beneficiaries are not
understood by Policy-makers

11MM farmers grow crops
110 MM Hectares of Land
Ave. 10 Hectares per Farmer.
Approx. 5MM farms >5 Hectares Size
1 MM farms > 50 Hectares.
8mm Tractors as of 2002.
Agrifood Contribution is 5%-15% of
total value added in economy.
Motive for using Galileo in Agriculture
1. Increased demand for statistics.
2. Higher demand for Licenses.
3. Linking Agriculture to environment.
Agri-output is = 50% EU Budget !
Direct stakeholders complemented by
People From Business-community &
Policymakers

GNSS Application Overview



AGRICULTURE & FARMING

**Agriculture is the Principle &
Farming is the Practice**

**Sustainable Agricultural Production System
is a Judicious Management of
An Understanding of
Seed, Soil, Nutrition, Water &
Other Agro-Chemical inputs
Like Fertilizers & Pesticides.**

Current Agricultural Situation

**Farms are usually beset with
Variable Production,
That can be ascribed to Pursuit of Different
Management Practices,
Depending upon
the Topography, Soil Heterogeneity,
Ascribed to Its Texture, Fertility,
Organic Matter Content, etc.,
Coupled With
the Environmental Conditions, like Weather,
& Other Factors like
Weeds, Pests & Diseases.**

1st Green Revolution & The Alternative

1st Green Revolution emphasized production without debating the long term consequences of decision-making.

It Was as if there was no option –as a consequence ecology & the Environment suffered.

The Alternative is to Enhance Efficient Use of The Meager, Natural Resource Inputs, In Order to Maximize Productivity, Without Inflicting Undesirable Consequences To the Environment.

ESSENTIALS OF FARMING

LABOR IN FARMING –

- **Hi Wages - Non-Availability in Time of Need; Choice of Necessity - Labor-saving measures should be incorporated in farm management to make it an economic profit-making alternative**

ENERGY-

- **Increasing Basic Fuel-costs impacts cost of Production**
- **Energy Saving methods should be cost-effective**

WATER

- **Irrigation demands 80% of water resources; now rationed by drip-irrigation; lowered water levels incorporates Salts which clogs the drips, restricting water needed in root zone.**
- **Adequate measures to quantify & qualify for irrigation**

Precision & Decision Farming

Agriculture Industry is More, Precision Decision Oriented & Management Intensive. Therefore, the Integration of, *Computer Applications, Satellites & Information Technology* are essential for the Management of Agriculture.

Precision Agriculture & Farming, Which is Being Practiced In the Large Farms in Developed Countries., Can Also be Adopted in India, by Land Planning as in China & Integrating Crop Management This can be implemented via Legislation. This can be Accomplished by Optimizing Inputs to Assure Predictable Yields, In a timely manner.

Precision Farming – Definition

**Thus, Precision Farming is Defined as
Information Technology Based,
Relatively Better Management System
that Identifies, Procures,
Analyzes & Manages,
Natural Variability Amongst the Fields &
Optimizes
Productivity, Profitability, Sustainability,
Which Protects the Land Resources.**

Need for Precision Farming (PF)

**Increased Land Degradation In India,
out of 169.7 Million ha about 144 Million ha of Land
are affected by Water or Wind Erosion Alone**

Depletion of Water Resources.

**Socio Economic Need for Enhanced Productivity Per
Unit of Land, Water and Time.**

Environment Pollution

**Because of Increased Use of
Fertilizers and Chemicals.**

**PF is Essential in Order to Address Poverty
Alleviation, Enhance Quality of Life & Food Security**

Current Practice – Correction And Objectives

The Farm Inputs, That are Currently Being Applied on a Blanket Basis, as Recommended by Research Stations, are as if, There is no Choice.

It Has to be Replaced by Effective Application, On a Case by Case Basis, Based Upon Experimental Verification & the Established Need.

The Objective is Not to Obtain the Same Results Everywhere, But to Distribute Inputs, On a Site-Specific Basis In Order To Manage & Maximize, Long-Term Cost/Benefit

Accomplishments of Precision Farming

Improved Crop Yield

**Make More Efficient Application &
Reduce, Chemical, Fertilizer &
Energy Costs.**

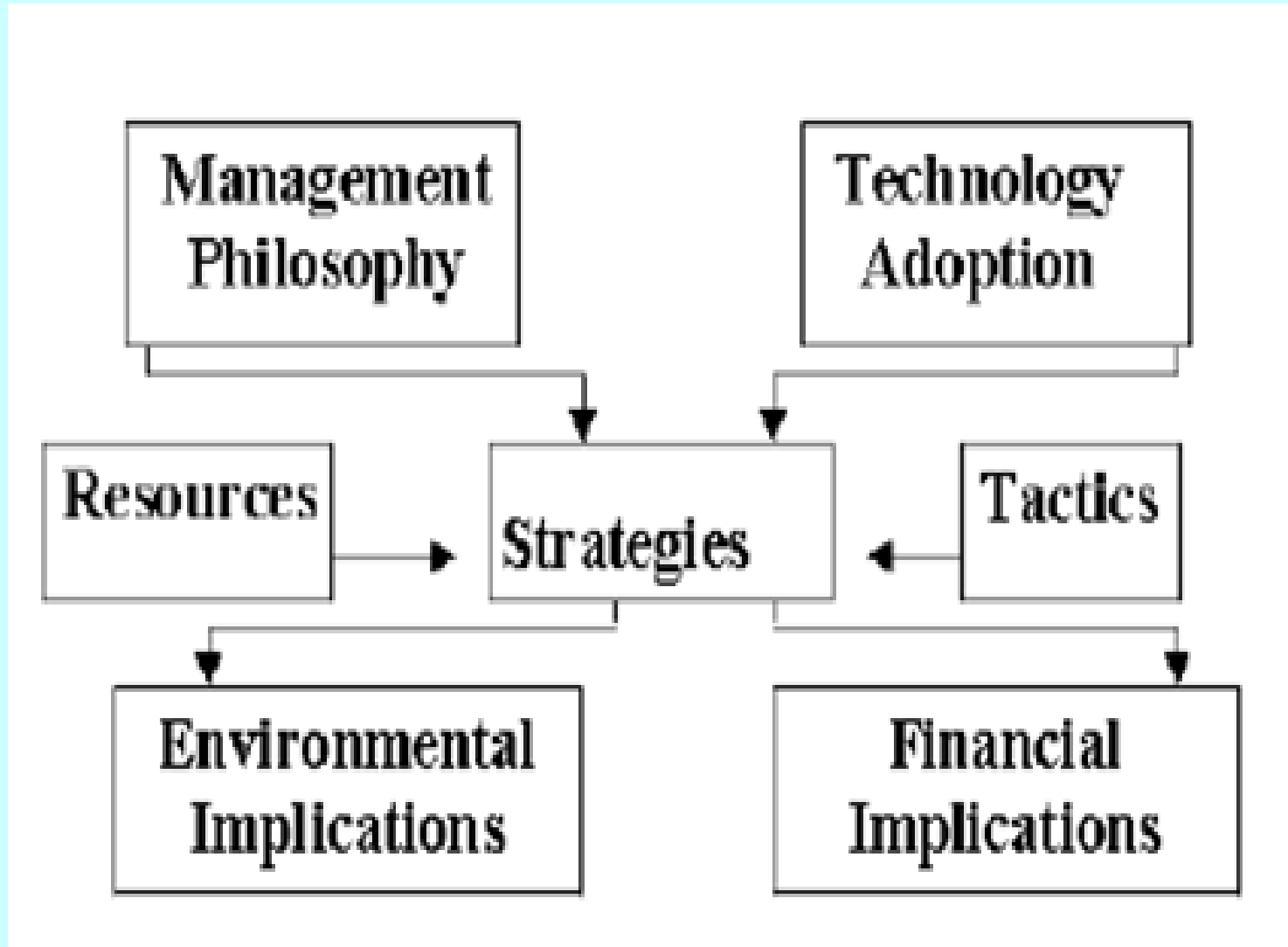
Increase Profit Margin

**By Rationalizing Activities &
Reducing Pollution**

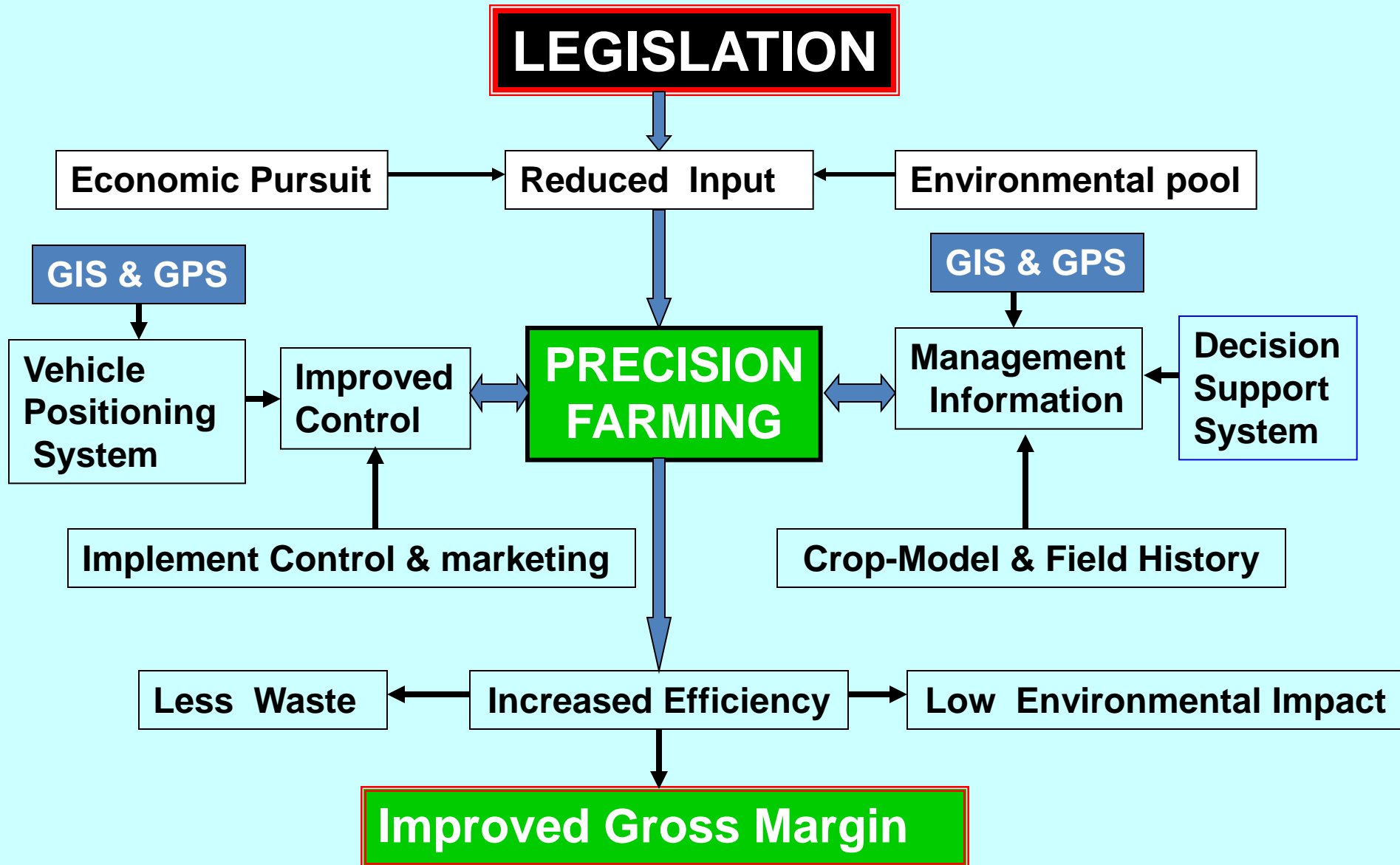
Generate, Accurate Farm Records

Enable Better Management Decisions

Steps in Precision Agriculture-1



Steps in Precision Agriculture-2



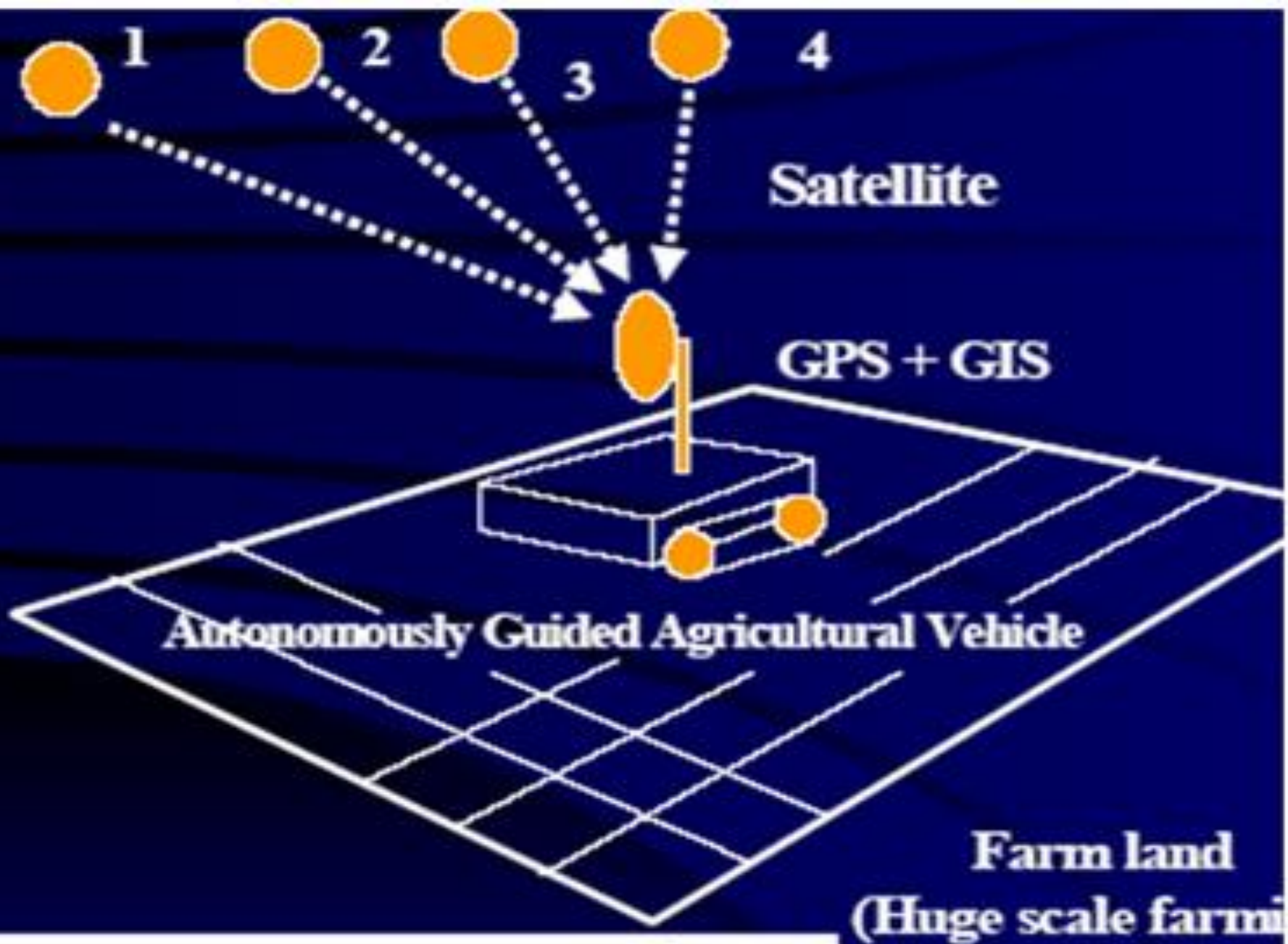
The P.F.Technology

The Technology that Enables P.F., is Known as Global Positioning System (GPS) Agriculture & Geological Information System (GIS) Or Variable Rate Farming.

There are two components.The Devices that are Used & The Information that is Acquired. GPS + GIS, Computer Software, Automatic Control, Infield and Remote Sensing, Mobile Computing, Advance Information Processing, & Tele Communication

Wireless Sensors in Agriculture

**Wireless Sensors & Sensor Networks
Applied in Agriculture & Food Production
For Environmental Monitoring,
Precision Agriculture,
Machine to Machine (M2M) -Based Commn,
Machine & Process Control,
Building & Facility Automation &
RFID-Based Traceability Systems**



CONCEPT OF PRECISION FARMING

GPS in Farm Uses

- 1. Mapping Yields**
GPS + Combine Yield Monitor
- 2. Variable Rate Planting**
GPS + Variable Rate Planting System
- 3. Fertilizer Application**
GPS + Variable Rate Controller
- 4. Field Mapping for Records & Insurance Purposes ;**
GPS + Mapping Software
- 5. Parallel Swathing**
GPS + Navigation Tools

Lightbar Navigation System Mounted in Cab & in View of Forward Travel.



Display Screens for GPS Navigation Systems



GPS w/ Altimeter & Barometer



Garmin GPS 60



**Garmin 010-00633-00
model eTrex Summit
HC**



**Oregon
Scientific
GPS Scout
Backtrack
Altimeter**

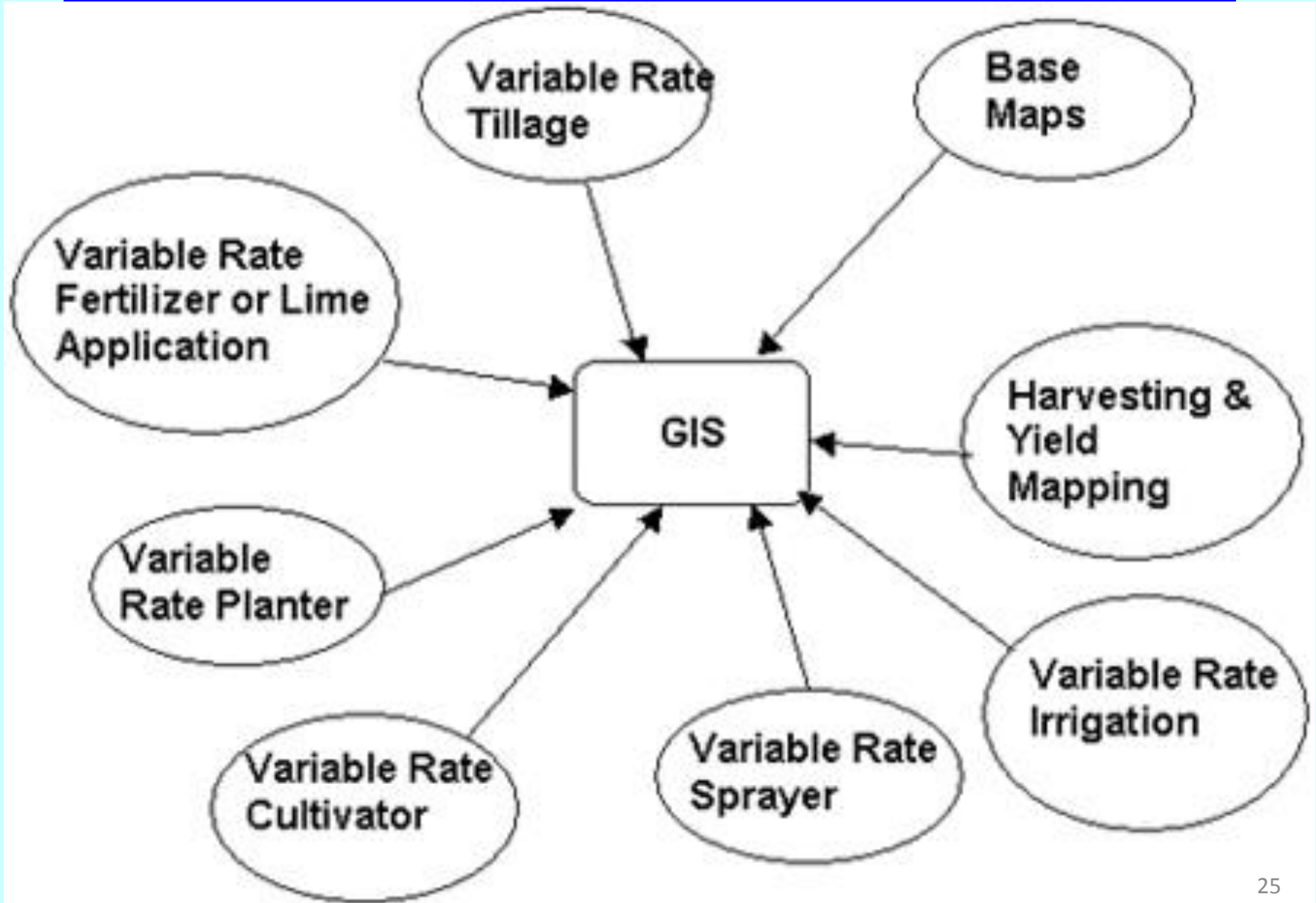
GPS Navigation System Mounted in a Spinner Spreader



Economic Benefits of GNSS & GPS in Agriculture

Global Navigation Satellite System (GNSS)
Machine Guidance can be Applied Widely in the
Grain, Cotton, Sugar & Horticultural Sectors
Using **“Control Traffic Farming”**
Can significantly **Reduce Input Costs;**
Study findings:
Annual Yields Up 10%;
Fuel & Oil Costs Reduced 52%;
Labour Costs Reduced 67%;
Crop Gross Margin Up by (\$110);
Around 10-15% of Grain growers in Australia
use GNSS for Machine Guidance;
Increasing Uptake Requires
Better Reference Station Infrastructure.

Geological Information System (GIS)



Geographical Information System (GIS) in Agriculture - 1

**GIS Consists of Data & Software
Designed for Spatial Analysis.**
**In the Case of Precision Agriculture,
the Farm GIS Software has
Tools Designed to Allow
the Display of Crop Yield Data &
Factors Which May Affect Crop Yield.**
**These Factors Include
Soil Fertility Data, Soil Types,
Insect Infestations , Weed Locations,
Rainfall Distribution, &
the Terrain Elevation.**

List of Open-Source GIS Software

MapServer/MS4W

Map Window

PostGIS

QGIS (Quantum GIS)

MySQL Spatial

Thuban

GeoServer

GeoTools

fGIS (Forestry GIS)

Degree/ iGeoPortal

GRASS

OpenLayers

GIMP

GeoNetwork

FWTools/GDAL/OGR

GVSig

ImageMagick

uDig

**Standards of Software Certified as per
Open GIS Consortium (OGC)**

Sample List of Free-Proprietary GIS Software

1. Google Earth –

It is a Virtual Globe,

Map & Geographical Information Program.

It Maps the Earth by the Superimposition of Images Obtained From Satellite Imagery, Aerial Photography & GIS 3D Globe.

2. ArcExplorer –

It is a Freely Available Lightweight , GIS Data Viewer

That Lets One Perform a Variety of Basic GIS Functions.

With ArcExplorer, One Can Display, Query, & Retrieve Data.

It Can be Used as a Stand-Alone Application With

Local Datasets or As a Client for

Internet Data & Map Servers.

Sample List of Free-Proprietary GIS Software -2

3. ArcGIS Explorer

**It is a Free 3D GIS Viewer Produced By
Economic and Social Research Institute (ESRI) Inc,
Dublin, U.K.**

**It is a Part of ArcGIS Software Suite.
AGX A Printer & Scanner Software System
Which can be Used as a Client for
ArcGIS Server, Arc Internet Map Server (ArcIMS),
ArcWeb Services & Web Map Service (WMS).
It Supports Many GIS File Formats,
Both Vector & Raster Such As
shapefile, GeoTIFF, MrSID, IMG and KML.**

Precision Farming Design

Shifting to Precision Farming one has to Deliberately Design & Manage, Site-Specific Requirements by Evaluating the Entire Field & Determining the Parcels of Land that Requires Specific Alternative Intervention.

Develop A Sound Management Practice Incorporating Both Economic & Environmental Benefits, Field Level Management & The Agronomic Technologies Required To Achieve these.

Obstacles to Adoption of Precision Farming in India

Culture & Perceptions of the Users
Small Farm Size
Lack of Success Stories
Heterogeneity of Cropping Systems & Market Imperfections
Land Ownership, Infrastructure & Institutional Constraints
Lack of Local Technical Expertise
Knowledge & Technical Gaps
Data Availability, Quality & Costs

Policy Planners' Objections - Adoption of Precision Farming in India

***“Precision farming is not new to India ,
which is practiced to get maximum output
from given inputs , in a given time period.
A book was published on PRECISION
FARMING - as early as in 2002 ,
which emphasized site specific management
of water nutrients, seed and plant health
as per the needs.
All our efforts to predict weather is not yet
authentic, so how can we predict the
needs based on GPS or GIS system”.***

Policy Planners' Objections -II

Adoption of Precision Farming in India

“We always compare with America where holdings are more than 100 hectares- compared to less than a hectare in India.

No doubt, decision support system is essential to enhance the output, which has many components and would need validation .

21 precision farming centres were established, computer based irrigation systems were recommended , but there are few takers, because of cost factors.

Undoubtedly, idea is appreciable, but need lot of analysis to go into a commercial venture.”

Probable Strategies to implement PF

Land Consolidation

Farmer's Co-Operatives & Corporates

Pilot Projects.

Cheaper Applications to Start With

Combined Effort of –

Researchers & Government

Inexpensive Way of Acquiring Images

With Camera in Visible & Infra Red

Bands Using Drones or UAV's.

Investment in Precision Farming

**Investments in Precision Farming
can be Complex & Costly.**

**A Vast Range of
Equipment & Techniques have to be
Used.**

**One has to Consult an Agronomist &
Hardware & Software Suppliers
Before Making any Investment Decisions.**

GNSS Applications

Are expanding in North America

- European Community
- Brazil and
- Australia

India cannot be an exception.

GLOBAL NAVIGATION SATELLITE SYSTEMS

US : GPS

RUSSIA : GLOSNAS

EUROPE : GALILEO

CHINA : BEDIU-COMPASS

INDIA : IRNSS & GAGAN



Thank You

for your kind attention !

**Also special thanks to Dr.J.K.Singaram, PhD.-Epigon
Srikanth N Seelin –Seelink Technologies
and Miss.Shubha S.S. -Staff
for support in developing presentation**

Dr. C.B.Jagannatha Rao D.Sc .Agri.(Tokyo)
Bangalore, Karnataka, India
jaganrao@yahoo.com