



AGRICULTURE AND FOOD DEVELOPMENT AUTHORITY

The Irish Agriculture and Food Development Authority

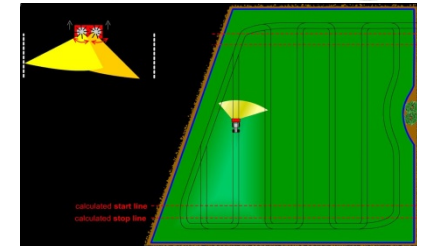
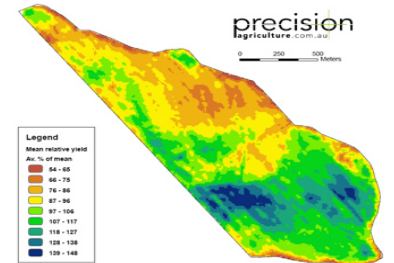
ICT and Agriculture

Teagasc perspective

Dr. Frank O'Mara
Director of Research

What is the opportunity?

- Most precision or SMART agriculture developments have been in cropping
- Irish agriculture is mainly grass-based ruminant production
- Need to focus our efforts here, and become world leaders in this segment



How can ICT help this farm?



Genotyping the herd

- Genomic selection has increased rate of genetic gain in dairy herd by 60%
- Custom SNP chip (Teagasc, ICBF, Weatherby's, Illumina) developed in 2013
- Ireland will soon have the largest set of genotyped animals in the world – 250,000
- New SFI funded project – *Precisiongenomics* – will leverage this data – 250 trillion data points



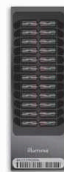
IDB SNP CHIP
INTERNATIONAL DAIRY & BEEF
SNP CHIP

Designed in association with the Irish Cattle Breeding Federation (ICBF), Teagasc, Weatherbys and USDA's Agricultural Research Service.

This custom chip is the very latest design catering for both Beef and Dairy. The chip consists of the Illumina LD (7K) base content plus a further 10,000 (10K) SNPs carefully selected to ensure very high imputation accuracy to HD & to convert to Microsatellite data for parentage verification. This extra panel of SNPs provides the very latest dual product for both Beef & Dairy breeds.

Both the core and additional ISAG recommended SNP parentage panels are present on the chip.

The IDB also contains a comprehensive selection of genetic markers to screen for genetic disorders & major genes.

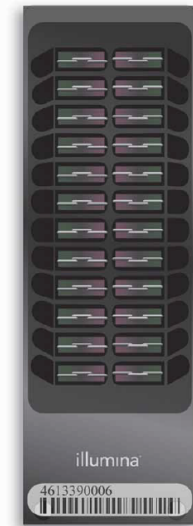


For more details Contact: Weatherbys Ireland DNA Laboratory

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CHIP CONTENTS FOR DISEASES & TRAITS

- Lethal recessives**
- 1 DM* Complex Vertebral malformation
 - 2 DUMPS
 - 3 Brochyspina*
 - 4 BLAD
- Congenital disorders**
- 1 Anthropopsis (Curly Calf)*
 - 2 Fawn Calf Syndrome or Contractural Anhidroticity*
 - 3 Hypotrichosis PM617
 - 4 Hypotrichosis in Belted Galloway, HEPHE1 SNP*
 - 5 Hypotrichosis KRT171*
 - 6 Spidderleg - MOC21 gene- Simmental
 - 7 Spidderleg - SOLUX gene- Brown Swiss
 - 8 Polledness
 - 9 Mule Foot
 - 10 Tibial Hemimelia (TH)*
 - 11 Black/Red Coat Color/Red Factor
 - 12 Red Recessive coat colour (Different to red factor)
 - 13 Silver Color Dilutor
 - 14 Dun Color
 - 15 RNF11 affects growth and stature)
 - 16 Osteopetrosis (Marble Bone Disease)
 - 17 Pink Eye (Infectious Bovine Keratoconjunctivitis)
 - 18 Protoporphyrin (Photosensitization)
 - 19 SMA- Spinal muscular atrophy
 - 20 Beta Lactoglobulin
 - 21 Beta Mannosidosis
 - 22 Alpha Mannosidosis
 - 23 Cinnamemia
 - 24 CMDI- Congenital muscular dystonia I
 - 25 CMDII- Congenital muscular dystonia II
 - 26 Crooked Tail Syndrome*
 - 27 Factor XI
 - 28 Ferrochelatase Gene
 - 29 Heterochromia Irises (White Eye)
 - 30 SDM- Spinal dysmyelination-SPAST Gene
 - 31 Idiopathic Epilepsy*
 - 32 Pulmonary Hypoplasia*
 - 33 Weaver
 - 34 Neuropathic hydrocephalus* (water head syndrome)
- Major genes**
- 1 DGAT1
 - 2 MSTN (GFDF) Double Musing*
 - 3 A1/A2 beta casein + *
 - 4.7 Fertility Haplotypes (#H1, H#2, H#3, J#1)
 - 5 Kappa Casein I
 - 6 Kappa Casein II
 - 7 ABCG2
 - 8 GHZ141
 - 9 IGF1- AFD17143
 - 10 STAT1*
 - 11 STAT2*
 - 12 STAT5*
 - 13 Calpain (Tenderness) loci



* Royalty fees may apply

Irish Agriculture and Food Development



Automating grass measurement and allocation

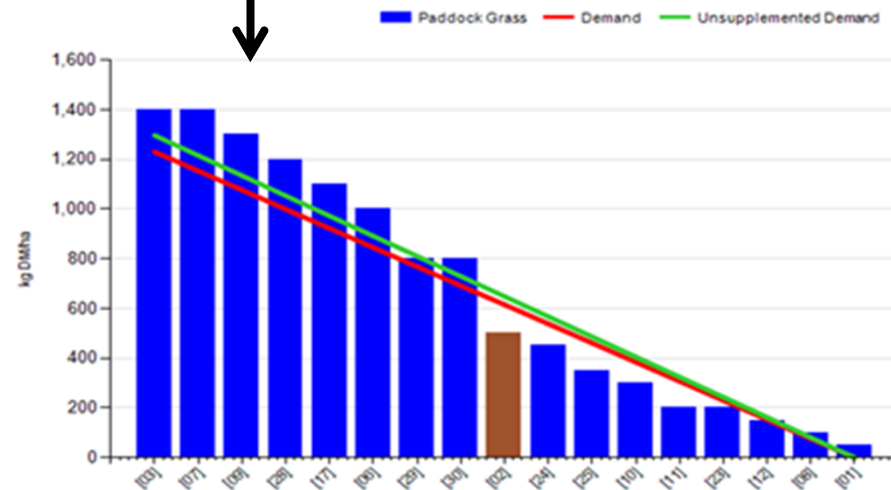
Should be done as precisely as weighing concentrate feeds

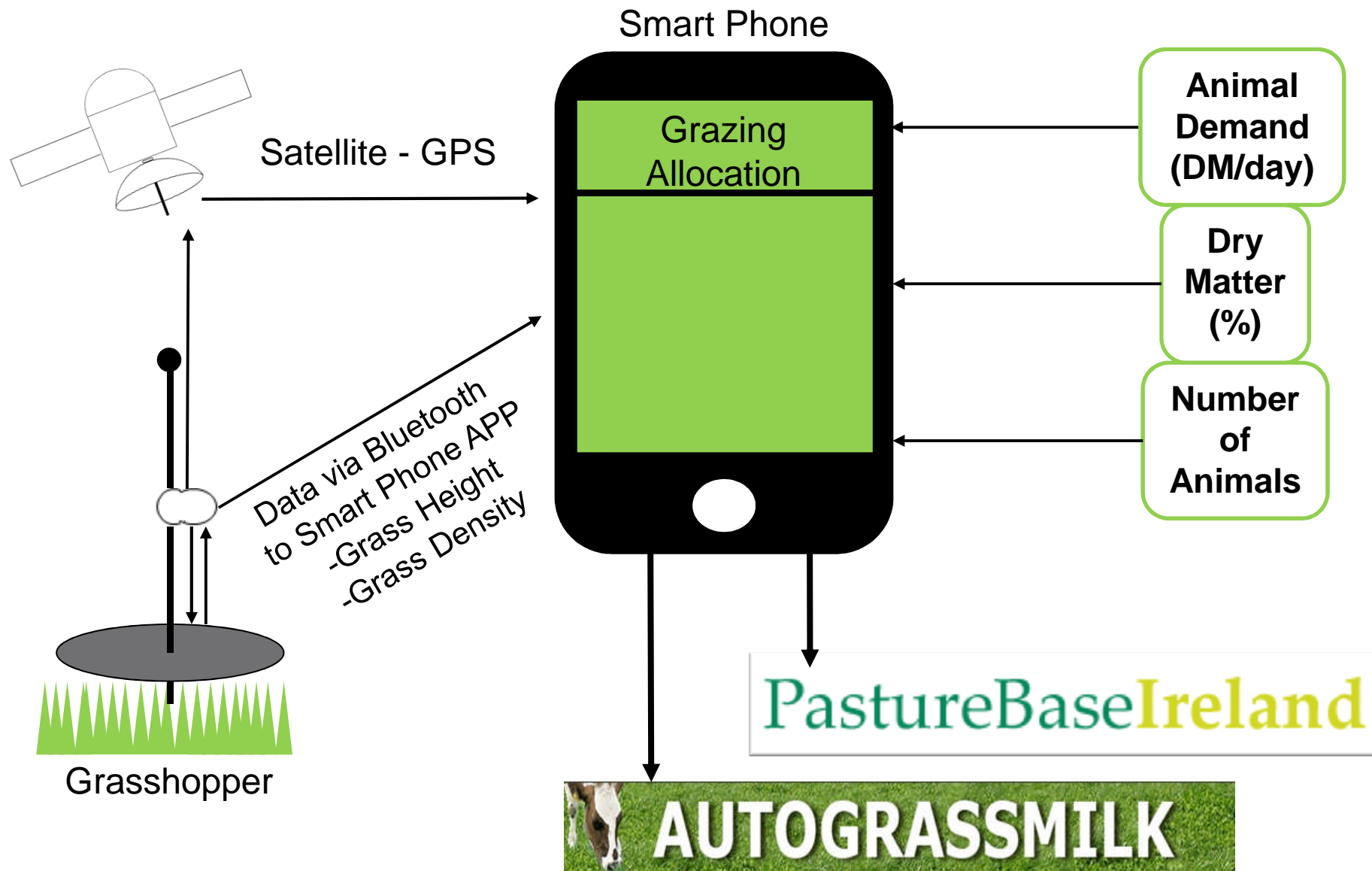
Good tools available, but need to automate them

Platometer to measure grass quantity



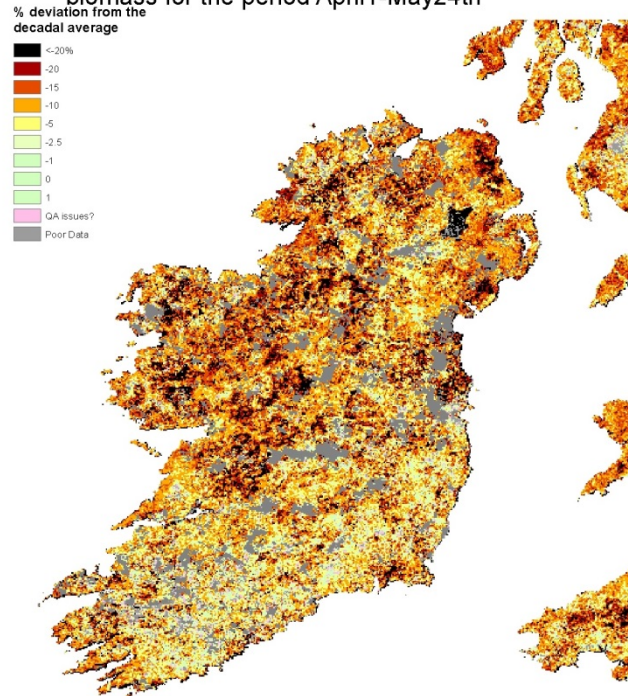
Grass wedge – a DSS that uses data from platometer readings to assess feed stocks and make decisions





Measuring pasture growth from space

Percentage difference from average accumulated biomass for the period April 1-May 24th



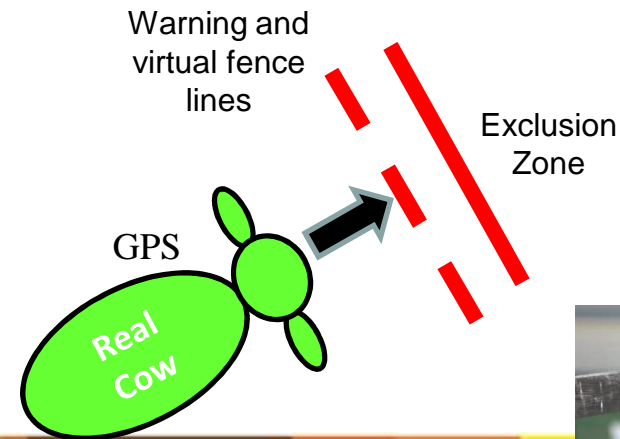
Based on NASA MODIS data- created by Stuart Green, REDP, Teagasc



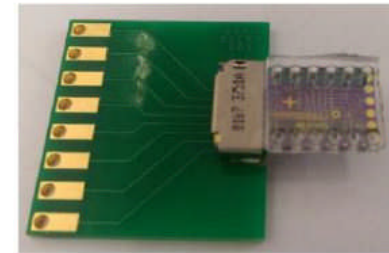
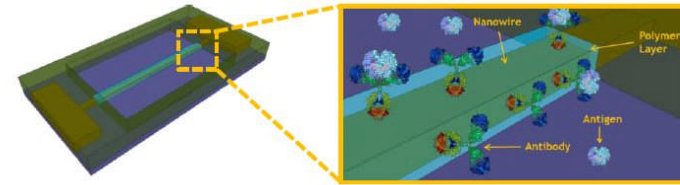
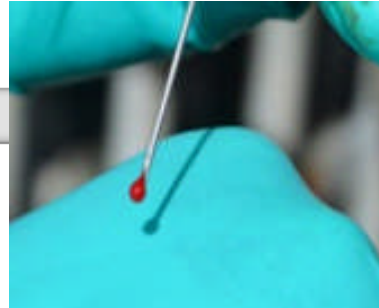
Drones could be a future technology for grass measurement



Virtual fencing – allocating grazing area without fences



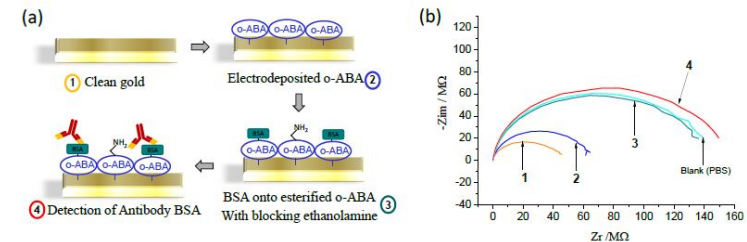
Biosensors in veterinary diagnostics



- Nanosensors to allow rapid on-site diagnostics
- To both replace and support laboratory based diagnostics such as ELISA

Advantages

- Handheld devices
- Small sample volumes required
- Microfluidics coupled to biosensor chip
- Results in minutes

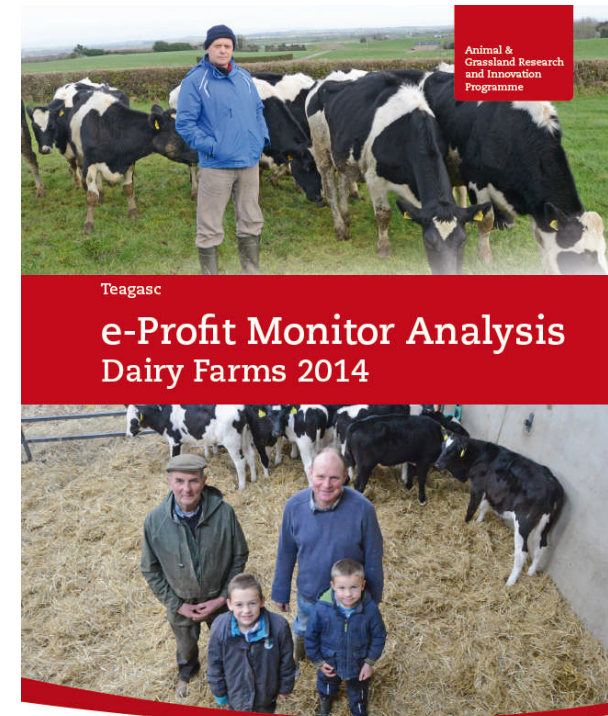


Currently working on BVD, Liver fluke, IBR, and IgG
Have achieved proof of concept for BVD antibody

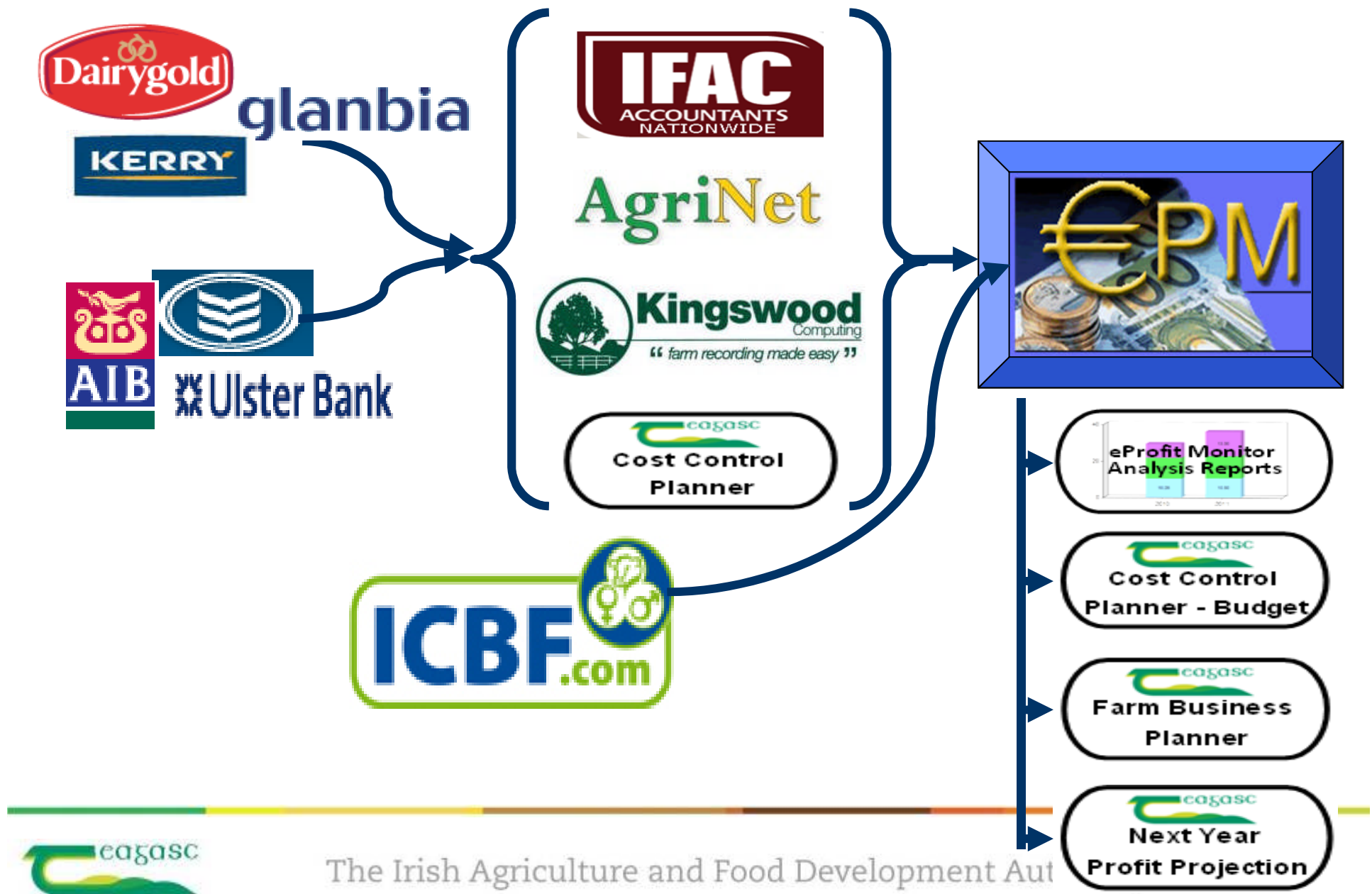


Farm Business Analysis

Teagasc e-Profit Monitor is an on-line tool to analyze performance and benchmark yourself against other farmers



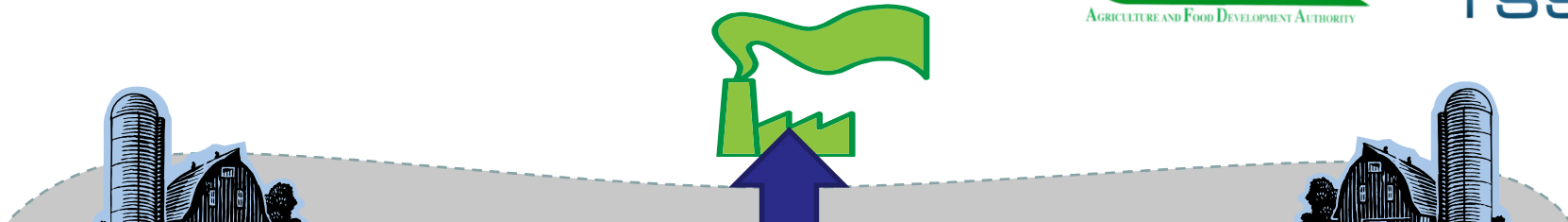
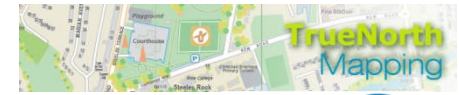
Farm Business Data flows



Many large databases related to agriculture

- **Department of Agriculture**
 - AIMS: Animal identification and Movement System
 - LPIS: Land Parcel Identification System
- **ICBF**
 - cattle/sheep breeding databases – huge amount of performance data
- **Teagasc**
 - PastureBase Ireland: Unique database of grass growth measurements
 - ISIS: Irish Soil Information System
 - NFS: National Farm Survey – 40 years x 1,000 farms x huge level of detail
 - €PM: unique on-line farm business analysis tool
- **Other**
 - Met Eireann: high resolution weather forecasts
 - GSI / OSI: mapping, lidar, aerial photography, Tellus project

PRECISIONDAIRY



Develop robust, accurate technologies that measure and communicate useful data from dairy farms, develop methodologies that interpret that data and finally to present the intelligent outputs back to the farmer in real time while integrating the collected data with national databases, all of which must be done in a low cost fashion

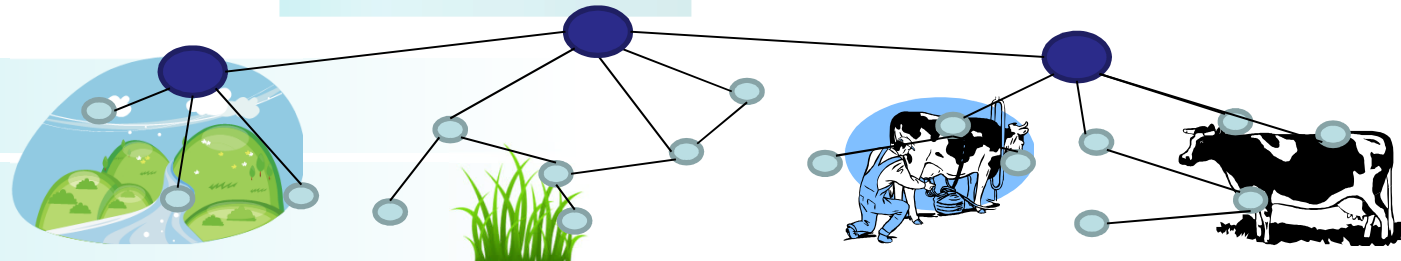
SFI-Teagasc funded



Also **Smart APPI** – develops supply prediction model for GILL and Dairygold
efficiency and productivity Data Mining and Analysis quantified sustainability

Sensor Comms

Sensor Design




How can ICT help this farm?

Many more:
robotic milking, animal monitoring, milk supply forecasting, nutrient management, weather forecasting, environmental measurement.....



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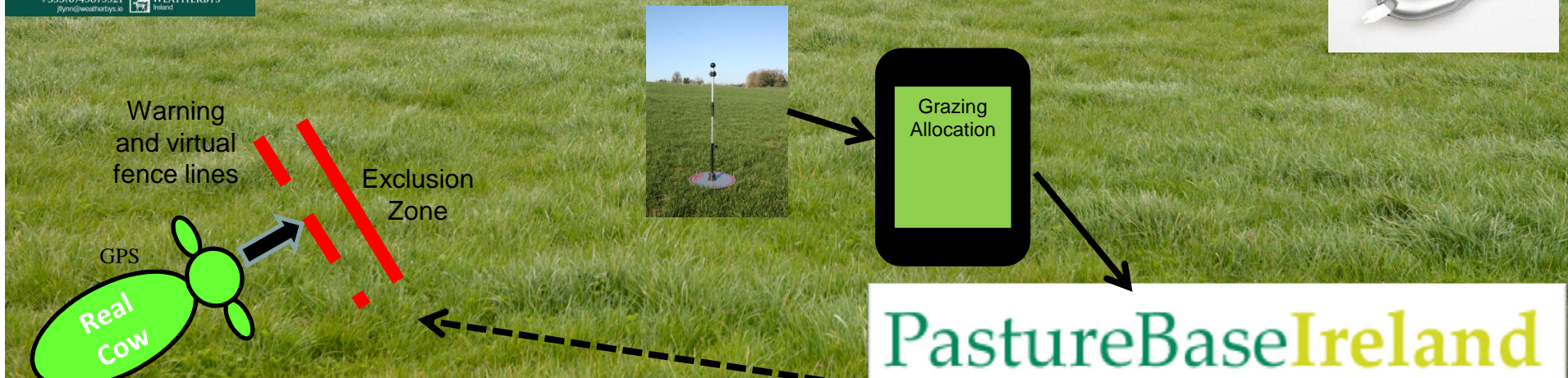
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jlynn@weatherbys.ie Ireland

Biosensors in veterinary diagnostics



Conclusions

- Huge possibility to improve efficiency, profitability and sustainability through use of ICT and related technologies
- Ireland has excellent databases, and research strengths in agriculture, ICT and sensors
- Opportunity to converge these disciplines and give Ireland another competitive advantage: ***the most data-driven livestock agriculture in the world***

[SFI-Teagasc funding available now for projects linking agriculture and ICT/Sensor scientists – SFI Investigators Programme]