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Farm-level data integration: future problems and consequences for public and private structures

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Abstract

One of the outcomes of the EC-FP7 project "Future Farm" was showing the need of INTEGRATION, something that PROGIS has been doing for 15 years. Within the whole sector agriculture–forestry-environment-risk management there is an enormous need for integration that is not available yet, because of on side the existing admin-sector-structures plus on the other side diverse public and/or private interests with opposite directions and in many cases the not streamlined interest of ALL involved parties. On the other hand we have the nature that is fully integrated and should be managed by us! Nothing happens without being related to something else within the nature. We have to be more aware of this and have also to understand that ICT will be the driver of integration as data and based on it these information is necessary and urgently needed for public and for private structures. We can do it separately, doing things in parallel and multiple times with multiple costs and reduced results. The other option is to cooperate on an integrative model!

Keywords: Commons, farm management, valuation of land, ICT,

1. INTRODUCTION

One sample to be mentioned is the EC subsidy payment model where the same information is asked by the government as the farmer would need for his farm management. The farmer must enter data twice, or even more often, because he enters nearly the same data for GLOBALGAP or another certification institute once more, or for a food chain a third time, for a logistics operator including the location a 4th time, and for an environmental body a 5th time as well as for the precision farming contract again (6th time) etc.etc.. It is always the same field and we have one principle law in IT: Enter data only once! And to type in the same data several times is not funny!

To solve this problem several facts are necessary to be mentioned: We need on one side an ICT backbone that is available for all within the chain and we must have basic data available like images, LPIS data etc. and basics like soil-, or geological-maps etc. have to be in common as further a meteorology- and/or soil-sensor network with agro-forest-environment expert models integrated (agro-meteorology can NOT be done by the standard meteorologists or the governmental met-office!).

Based on such a backbone, private and public structures can easily operate with their own applications and the results can be transferred and made downloadable for the partners in a trust center on bilateral agreements or on legal requirements. Suddenly it would work if farmers arrange with their buyers the need of documenting the pesticide use and make some data downloadable for partners. In a risk case the Minister would also get access.

Beside ICT backbones and trust-centers, standards for data-communication (interfaces, norms etc.) for the whole horizontal and vertical sector integration have to be set up. An ISO-Bus as pushed for precision farming needs is too less.

From cooperating with farmers we can learn since Raiffeisen started his cooperative concepts: Several elements only can be setup together. Not every farmer will have a silo to store his grain and not every farmer is able to manage his own export etc. Similar facts will be valid for an ICT backbone. The attempts of the past, bringing farmers closer to ICT failed during the last years. Not because of the farmer`s disability but due to his feeling that the technology does not fit his needs and solves only few of his many problems. This happened because of the non-integration and the attempt of big players in the market like tractor producers, agro-chemistry giants, certification bodies, the Ministries etc. to setup own solutions without thinking on farmer`s needs – NO INTEGRATION happened.

A study of Ehud GELB done with experts continuously between 2002 and 2008 showed a percentage rising from 50% to 70-97- 95% in 2008. More and more experts did not believe in uptaking ICT within agriculture. Why? Because of non-integration and a setup of solutions for everybody within the chain but not for farmers. They refused – they were correct!

Beside this non integration following other facts were not settled correctly to arrange the uptake of ICT within agriculture and forestry:

1. The public private antagonism,
2. The top down versus bottom up need,
3. The availability of basic data and
4. The total different structures with huge differences within advisory services,
5. The – wrong – integration of the sales into the advisory process,
6. The farmers private ownership versus the public freely available commons,
7. The farmer and the common understanding that farm- and forest management automatically must be environmental management,
8. The not yet understanding that technologies like precision farming or logistics are equal to significant CO^2 reduction,
9. The wrong GIS developments with top down approaches only and last but not least
10. The attempt to externalize costs from many groups on the shoulders of the nature, in many case on the farmers and foresters worldwide and
11. The non-valuation of land as one of the farmers most important assets.

More details to the above mentioned points:

1.1. The public private antagonism:

Every piece of land delivers beside the return for farmers or foresters in form of harvest results like crops or logs also an amount of services like air quality, local climate, recreation, bioenergy, carbon sequestration, water supply with quality and quantity effects and water

storage, risk reduction related to a large group of environment based risks like flood, landslide, torrents, avalanches, rockfall, mudflow, desertification etc. etc.

Most of these services can be influenced by agriculture and forestry and do not come automatically with standard or even GAP based agriculture and/or forestry. We need for the future integrated models that give us the basics of the nature, the carrying capacity, the priorities of needs that the nature should support and a model how to manage this within a public private cooperation.

The first pilot projects were developed together with the Austrian railway- organisation that had a problem of rock-falls on their rails within the Alps. After a risk-assessment of a first pilot project, the farmers got jobs defined on their land to work in their forests in a way also to reduce rock-falls. Logs are still growing but besides that farmers had to grow bushes, no plain-cut was allowed etc.. For their work for the benefit of the railway organisation they got yearly paid according an agreement that was set up - a win-win situation for the farmer, the railway organisation and the insurance company.

1.2. The top down versus bottom up need:

The information change in rural areas happens at the farmer´s location and not in the office of a public department. Every map that is produced is a historical map if not updated – just the question of history has to be defined, 5 days, 5 months 5 or 500 years etc.; on the other side the farmer is at his location every day and knows about his piece of land in many cases more than anybody else and knows also the latest status quo.

On the other side public departments build up maps based on the model "information is power" and just distributed the maps without giving the users, the farmers real possibilities to use these maps for his own management. The farmers could look at a picture, could also print it out but were not able to use these pictures for their own purpose and other – see above – public and private needs.

1.3. The availability of basic data:

Also when with INSPIRE a right step driven by the EC was done, the access for farmers to basic data like cadastre data, soil maps, geological maps is still complex and expensive – expensive especially when calculating the order-model that in many cases is too complex for farmers and needs lots of time and effort to manage the orders. Farmers and foresters have to get easy access to public data, this also in a manner that these data can be used within their farm management systems and not have to be build up and/or entered twice.

1.4. Total different structures within EC advisory services:

There is according to a study done by the EU-JRC a huge difference in advisory services within the European member-states. Denmark has 60 advisors per 1000 farmers, organized by a cooperative private structure that is additionally supported by the government, where other countries have between 1 and 6 advisors per 1000 farmers (exception is Czech with 13 private

advisors per 1000 farmers, but relative new) only. Are Danish farmers more stupid than others? NO!!! For sure they found out earlier that qualified advice pays off, for the farmers AND for the government and for the public.

Today advice is focusing in many cases only on the GAP targets and has in many cases nothing to do with a real advise as it should be.

1.5. The – wrong – integration of the sales into the advisory process:

We have within agriculture so called pesticide advisors, fertilizer advisors, machine advisors etc.; when we look into more detail we see that the advisors are in many cases sales people. Their first target is to sell more! We have to be able to optimize the use of machines as well as to optimize the use of fertilizer or pesticides and differentiate for this between sales and advise. The name "advisor" should be protected and to be used only by real and professional, also certified advisors.

1.6. The farmers private ownership versus the public freely available commons:

Everybody is aware of the commons and the problems of them in the past. Today we still did not learn that commons will be overused, also when the models are more sophisticated and the results are hidden or not published. With the – necessary – access of everybody to e.g. forestry also problems started to occur, that means we have to organize things better. When everybody can run everywhere we start facing problems. With free access to the forests we have only one sample mentioned, others are free use of water, right of risk reduction to protect downstream lands etc. ; partly it is discussed that such factors should become human rights – what is not negative but someone has to allocate these benefits – in many cases they do not show up without management of natural resources – and this is related with costs. To enable in the future, models have to be setup, what of these benefits do come automatically with standard farming practices and what has to be managed separately by farmers. This has to be compensated separately – but not only in general as in the past – GAP - but also based on detailed plans with targets, fulfilment, control etc.; these plans have to be setup on norms and standards and must be based on factors like needs, carrying capacities etc. A globe that contains nearly 10 bio people like the prognoses for 2050 show must be managed differently than a globe with one bio people as not long ago in the past. But we use today the same models as in the past what is wrong and does not fit and support our future needs. Growing problems worldwide show that the model is wrong and that we have to change something – with urgent need!

1.7. The farmer and the common understanding that farm- and forest management automatically must be environmental management:

The above targets can only be achieved when the whole population is better informed about the farmers real tasks and possibilities and when politicians of the different colors stop blaming farmers. We have to inform everybody what is the future job of farmers, we have

beside crops and logs also to define what they have to do and we have to measure objectively their work and pay for it. Otherwise we will not have the results we need.

1.8. The not yet understanding that technologies like precision farming or logistics are equal to significant CO^2 reduction:

Farmers are part of the problem but as the only group also part of the solution. To minimize or stop climate change and with it to do more carbon sequestration are necessities for the future - worldwide. The today´s agricultural practices and also subsidies do not reflect the possibilities of reduced carbon with the help of newest technologies. Optimized logistics means less driving what is equal to less carbon exhaust. Precision farming means less carbon due to reduction of fertilizer or pesticide use. Legislation does not reflect this yet. There is an urgent need to support farmers to use better and new technologies and to get better advise in the sense of a real management consulting of the whole farm.

1.9. The wrong GIS developments with top down approaches only:

All member states build up with lots of money and effort GIS systems that support subsidy management and control – what was good and correct. In many cases the systems are used also for the different agro departments to support them in their survive but do not support farmers as it is not public target to do traceability, management calculations, logistics, precision farming, fertilizer balances etc. ; the farmer needs in the future to get access to the existing data in an easy manner and must be able to send subsidy claims also from his management tool directly to the government applications, as otherwise he has to do data entry twice.

1.10. The attempt of many groups worldwide to externalize costs on the shoulders of the nature, in many case on the farmers and foresters shoulders:

There are beside carbon or sulfur or NOx etc. exhausts lots of other negative impacts on farmers or foresters soils and land. In many cases these impacts are not measured and also not compensated. If wanted, complex expertise has to be done and paid to get a chance of getting back partly the damage. My practice showed periods in front of a court of 20 years and more – this in “democratic” Europe!

We need better rules to enable farmers to take better care for their land also in the case of immissions done by third parties.

1.11. The non-valuation of land as a very important asset for the future:

Beside the farmers return of invest, he has a large asset in his ground. This asset can be influenced by management practices or also by external factors. Such can be also immissions from third parties – like e.g. immissions of NOx, S, CO2 etc. that influence beside the return also the value of a piece of land. We need to protect the farmer as a trustee of his land for all of

us that damages on his land have to be compensated with the target to get the land back in the original status.

To give an overview where technology can help to solve also above mentioned problems, in the following lines I have summarized some of the possibilities that are available today and will support the farmers, foresters, but also advisors as well as horizontal and vertical chain partners like the industry, the cooperatives, the machine drivers etc.

2. ICT BASED INTEGRAL LAND-MANAGEMENT TECHNOLOGIES – SAMPLE:

We summarize subsequent the benefits of integrated technologies where farmers, advisors, contractors, supply chains, industries and consumers are integrated:
GIS gives detailed information on size and location of fields - base for calculation and logistics. Farm management tools allow cultivation planning, documentation (also GLOBALGAP), nutrient- and CO^2-balance, cost calculations and provide information for trust centers or farm advisory services.

Logistic solutions with central and mobile GIS systems allow planning of complete regions and serves farmers, food-industries and contractors. Meteo-data allow better decisions. Business-plans assist cooperation with banks and insurance companies. Machine interfaces allow the set up of precision or virtual farming solutions for groups of users, further statistical analysis for regions or countries and a possible upgrade with forest- or environmental caretaking solutions are supported. Risk management solutions can help to better defining and measuring farmer's integration into environmental caretaking. We can show solutions and discuss the requirements – technological and organizational - to use these technologies.

3. THE OVERALL CONCEPT - "AGROFFICE"

is, to support farmers and/or foresters – in the future I use the item "farmer" for farmers and foresters - and their horizontal and vertical chain-partners with new ICT technologies that allow them to work better, to lower costs, to increase benefits and also to lower environmental impact or increase the natures capability to lower natural risks. This means beside detailed know how of farmers or their chain partners needs, a detailed know how of the nature and their capabilities as well as an overall organisational structure and concept is necessary, either already available or to be set up. The farmers worldwide must be enabled to work for the production of food for 10 billion people after 2050, for sustainable and CO2-neutral bio-energy as well as for environmental caretaking and natural risk management

4. TECHNOLOGIES BEHIND – "WINGIS + APPLICATIONS"

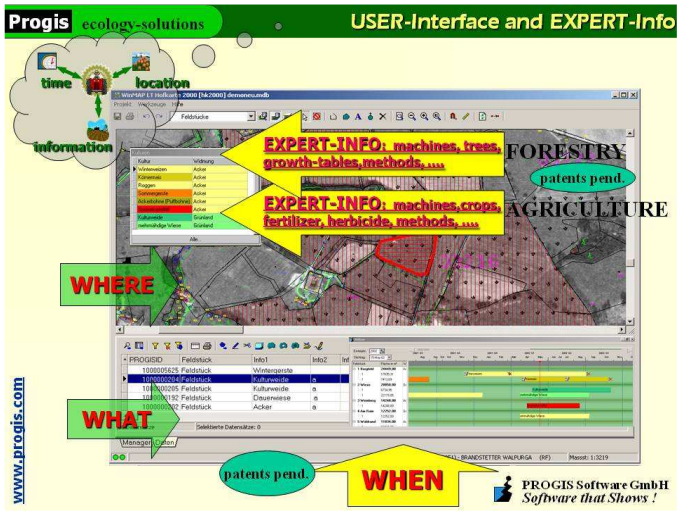
are after a development cycle of nearly 15 years including thousands of installations in more than 20 countries an object-oriented and hybrid raster- (images) and vector- (polygons, lines, symbols, text etc.) GIS (Geographical Information System) named WinGIS that beside the

location and the link of an object to a database with an internal or external database also enables the use of

- a SDK (Software Development Kit) to link any database with AX-technology to the GIS component as well as develop with tools customized user-interfaces that allow an integration of time and activity management as well of an expert information system.
- Since 2010 in cooperation with Microsoft, their worldwide available Bing maps (www.bing.com) – also other maps can be used instead or crunched – are linked to the system and allow to work in any country worldwide immediately. Also a Google maps interface is available.
- Further around 20 applications are supporting agriculture, forestry, environmental caretaking and risk management as well as the integrated chain-partners.
- Last but not least we also so to speak work as a system integrator and link existing other technologies to the system: Samples are weather stations, mobile equipments, RFID technology, GPRS or UMTS communication etc.

5. USER INTERFACE

The key target was to develop a user interface that allows the farmer or the advisor or on the mobile equipment also the tractor driver easy to learn and to use the interface that was improved to a 4D-GIS with the 4 elements hybrid geography, a database, time- and activity management and a downsizeable expert information.



6. FARM MANAGEMENT – "DOKUPLANT"

It is based on an expert system that can be developed and sustainable maintained by local agricultural experts and contains all machines and their costs and efforts per area (ha, acre etc.), all pesticides with their chemical active substances, all organic and inorganic fertilizer with their

nutrient contents as well as all the crops and varieties. Further based on this content all the activities during a year or a crop season have to be foreseen in all details for all crops, e.g. to grow maize needs step no 1 a tractor and a plough, step no 2 a tractor with a fertilizer equipment linked and NPK fertilizer and so on. The average farmer or advisor can just use the expert info, the upgraded user can maintain expert data himself and modify them according his know-how.

This allows to plan all details with a click on a polygon on the map – representing the field and either to be drawn on the raster-map or with GPS points to be imported – and select a crop – with all the details of the expert information in background. The rest is just output. Beside planning during the year, all the done activities have to be recorded, either with manually input or with a link to mobile equipment.

On output, following possibilities are foreseen for a field or for the complete farm: Calculation of costs, returns or contribution margins, calculation of nutrient balances (or also energy- or CO2 balances), documentation of all activities and transfer of the data (or part of them) to chain partners or to a trust centre (see later), sending a subsidy claim to a ministerial IACS system (EU(27) only) or to any other host computer and further creating thematic maps.
What can be done for a single farm can be managed on one PC for many farmers with advisors. It allows also comparing anonymously crop statistic of different farmers.

Naturally the advisors also know the use of fertilizer, pesticides or seeds etc. for their regions; several advisors can be bundled to a region and many regions to a country. A new ICT based advisory system can be set up – details see later.

7. FOREST MANAGEMENT – FOREST-OFFICE

Beside agriculture also forestry can be managed – this in two forms: Farm forestry as a part of the a.m. management just that the time is not 6 months but 80 or hundred years and the activities are managed as part of the existing expert system. Further a detailed forest inventory and forest management application is available – Forest-Office - that manages in a plot based or even statistical based manner any forest enterprise or many of them with an advisory tool.

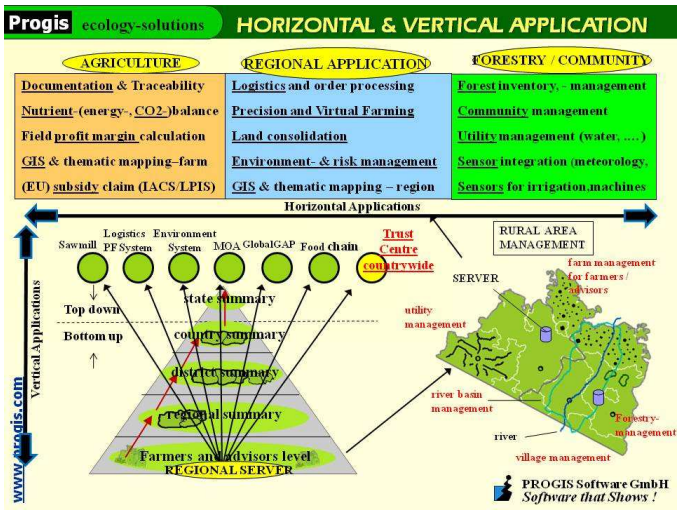
Local growth tables are available and must be managed once per country by local forestry experts. Based on the measurements on location like habitat data also wood data, e.g. relaskop measurements for volume per stand and growth per stand and their later input (manually or digitally), lots of output for compartments or for the complete forest enterprise can be done like: inventory and reserve, growth data, planning data, grouping on areas, graphic output for age and sort distribution, any thematic map, age distribution, general description of sub-department, tree sorts, quality distribution, harvest categories, growth acc. sorts and age, quality distribution, volume per region, general descriptions, harvesting plans, damages per type and region, planned sanitary cutting etc.

8. OTHERS – COMMUNITY-GIS AND PIPEGIS

Beside the agriculture and forestry, further applications are available as such for community management as well as pipeline- (water, waste-water, oil, gas) -management to be able to cover complete rural areas if needed.

9. HORIZONTAL INTEGRATION

As the farmer is in many cases not working alone but in cooperation with neighbours or in cooperatives, an intelligent ICT solution has also to reflect the so called group needs and the integration of the farm management system or parts of it into these group needs. Naturally large farms can be seen as "one owner horizontal integrated fields" that also can use the successive applications resp. technologies. Important during the development cycle was the setup of the technology in a manner that also small farms can be integrated and benefit from these new and exciting technologies with the help of a service provider.



10. LOGISTICS – LOGISTIC CENTRE AND MOBGIS

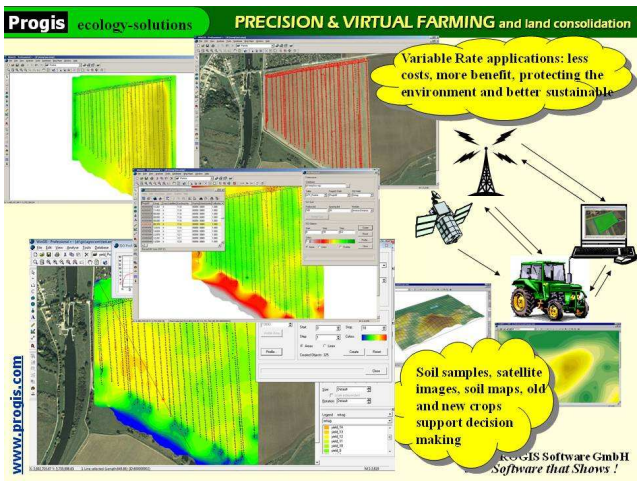
is the – GIS based - know how of all the locations of different fields integrated in a control centre that guides the machines and/or trucks to a field with GPRS/UMTS communication to a mobGIS. The local driver can answer with a push of a button that he got the contract "Where to go and what to do" and later on responds when he finished his works: e.g. how many sugar beets put for later pickup. The update frequency is software depending, in practical work we use 30 seconds what is more or less online. When the central GIS knows where e.g. the sugar beets (sugar beet was the first project, today it is open to ALL crops) to pick up goods, it sends another contract to a pickup machine and this machine invites based on the know how of how many tons to be loaded, two, three or four trucks that are linked with e.g.

a TomTom routing tool. When the truck is loaded, mobGIS transfers the dataset into an RFID that is located on the truck and the truck drives to the factory that get a just in time delivery of let´s say 100 trucks a day – and not 50 or 150 because both would cause problems. Crops and data are then unloaded!

In the same manner as a contract can be send from a control centre to a mobGIS, a farm management tool, DokuPlant, can send a contract to the control centre that manages the use of machines. Suddenly we see how farm-management tools, control centres and mobile equipment can work integrated together. In a small farm structured region, the control centre will be driven by a local service organisation, e.g. a chamber, a machine cooperative etc., large farms will run this centre themselves or even cooperate with smallholders as a service.

11. PRECISION FARMING - WINGIS BASED PF TOOLS

Precision Farming is, based on lots of detailed data of the soil, the variable rate application with m² detail for fertilisation and spraying on the fields. The technology needed is on one side the input of e.g. soil maps, soil lab results, Rapid Eye satellite images with chlorophyll data or using data of the Sebal field look model or any other information that might help to define better where should be fertilized/sprayed how much (soil maps, crop rotation, ...), further the defining of maps – a WinGIS job - that show the variable rate application and transfers it to the server that forwards a precision farming contract towards the mobGIS system on the tractor. There, with a blue tooth interface, a standard tractor console can read the data and trigger the fertilizer or sprayer equipment with the map content. After finalising the work the information "what has been done" is registered and sent back via server to the farm management tool where it can be embedded. The technology of transferring maps is working, the ISO/CAN buses makes the interfacing not yet a 100% plug and play but coming closer to it. The key question stays: "Based on which field information the decision of the variable rate application is done?"



The model allows to use for precise farming 1. old tractors and old e.g. fertilizer equipment and work with the help of a laptop to shows the location and where to change the kg/ha "manually precise", 2. a old tractor with a new fertilizer equipment can be upgraded with PC that triggers the new equipment and 3. is the use of a new CAN-bus driven tractor.

12. VIRTUAL FARMING

Is the integration of several small plots – small and bad shaped – to a larger plot that can be easier maintained with machinery. The cost difference might be 50%, 100% or more depending on size and shape. When it is possible to protocol with precision farming the costs and later on also the earnings per m², we can also define how much farmer A or farmer B gets in return, precise calculated. In Germany we are running the first test cases with excellent results and also acceptance of the farmers based on significant cost reduction. You can run in such a manner one or several activities on a field. Pre-condition is a contract between farmers. They might be organizing it by themselves or the government sets incentives and is supporting it with land consolidation units.

13. LAND CONSOLIDATION – WINGIS AND Z-GIS-APPLICATION

is the optimizing of bad structures (fields far away from the farm, bad shaped, to small, bad infrastructure etc.) to better ones and is normally supported by government. The Lower Austrian government is using WinGIS and a Z-GIS-application for land consolidation throughout the country. The data are gathered digital from a large cadastre system and are managed within WinGIS and Z-GIS with all details that are needed. After finalising a project the accepted results are stored back to the cadastre system.

The huge advantage is: Variants can be calculated "on the fly" in front of involved farmers; the acceptance is high, fast decisions + visualized information supports results. A significant cost reduction of land consolidation as well as a faster project cycle could be reached. PROGIS has worldwide sales rights for the applications of the Lower-Austrian government.

14. ENVIRONMENTAL AND RISK MANAGEMENT - FOMUMIIS

More and more people start to understand that agriculture and forestry are producing more then food and wood only. Clean water, fresh air, nice landscapes, less risks, sequestrated CO2 or better recreation possibilities are only some samples of the many benefits the nature produces. In general those benefits are economical, ecological or socio-cultural. With nearly ten billion people on the globe after 2050, human society will demand more multiple products and services from – sustainable managed - global resources, but such services can´t be free of charge and someone has to pay the real costs of the technical production without any degradation, staying within the natural carrying capacity. FOMUMIIS is an expert tool. Experts describe the needs of information to be gathered onsite and then it is calculated the weighted capacity of single landscape elements against some predefined targets. Farmers can optimize the model due to their work and increase the capabilities of a piece of land.

The first large project was set up in Austria with the national railway organisation where local farmers on their steep forests work with the target to protect with their forest – growing

bushes, no clear cut etc. – that stones fall down on the rails and might hit a train. Experts described the todo´s and the farmers get paid for implementation. New projects together with UNIDO are ongoing. Based on these examples, millions of new workplaces in rural areas can be setup in the next years, farmers will have beside food+wood+energy a third leg to stand on, environmental caretaking and risk-management. We have to define the targets for the benefit of all of us.

15. VERTICAL INTEGRATION

The farmer is also linked within his chain of suppliers and buyers; the complexity of an agro-chain management compared with e.g. a producer of a car is much more complex because of the enorm different structures of farmers (1 ha till 100.000 ha+) and buyers (single person till food-giants) or suppliers (also one-man shows till giants).

16. CHAIN MANAGEMENT

The behaving of large market partners is mainly driven by their own interest – you farmer have to enter your data in my homepage. The Minister in Europe started this with IACS subsidy systems. The farmer has not yet really a chain management technology with IT nor is able to handle many homepages of buyers or suppliers or public players to enter information about always the same field: where he is buying seeds and fertilizer and where he is getting subsidies and where he is using pesticides and where he needs services and where he is selling all or part of it to one or more buyers.

This has to be handled by an intelligent farm-management-system that distributes the information that the farmer wants or is legal necessary to share with different market partners. DokuPlant has embedded such a possibility, that the farmer/advisor defines, who will get which information.

17. TRUST CENTRE

Instead of sending the different data to many users, all data can be send to a so called trust centre that manages the access rights to the data. One IT centre for all chain partners, setup with new cloud computing technologies. An ideal model will be a trust centre that is managed by a consortium of market partners country by country and where partners define bilateral who gets which information and the Ministry can act on a legal base to have access to the information in a worst case scenario. Such a shared trust centre will reduce the costs for every market partner to a reasonable sum.

18. SYSTEM INTEGRATION - SITE ANALYSIS AND SOIL MANAGEMENT

As base for precision farming precise soil information will be needed; for that the intensive cooperation with soil-labs is necessary. Beside labs also the cooperation with data sets coming from satellite (Rapid Eye and their chlorophyll maps or the Sebal Model from NL) will enhance the recommendation data sets. The better the data, the better the PF results.

19. AGRO METEOROLOGY INTEGRATION

Weather stations are today able to measure for one microclimate all important weather data incl. also soil moisture data and transfer them via GPRS (offline data-storage also available) into e.g. WinGIS for further processing. Based on expert models decisions about spraying can be done very precise and farmers can be informed via SMS where to spray when and what. The focus is on reduction of sprays per crop season and so reduction of costs and environmental impact. Weather-station models can be together with advisory services set up countrywide and normally have a ROI of 1-2 years at the most.

20. ENERGY AND CO_2 BALANCE

Every work of farmers is involved with energy and/or with CO2; when a farm management system like DokuPlant counts every step, the energy/CO2 impact of this step (e.g. driving a tractor with a plough or fertilising so many kg NPK per hectare) can be counted by standard data out of an expert dataset. If one counts all activities on the field you are able to calculate a CO2/energy balance on the field. The same is valid for a farm, for a region or for a country. A control can be done easy with statistical sampling.

Such a model gives the possibility to calculate incentives for farmers that work with a positive CO2 balance, e.g. they increase the wood stock or they increase the humus content in the soil or they use logistics and run less km with a tractor per hectare or they use precision farming and use less pesticides or fertilizer per ha.

21. BENEFICIARIES

An integrated model has many beneficiaries. From the Minster that has better farmers to the farmers that get better tools for managing their farms or get better support by advisors till to the advisors that are embedded into a powerful tool that is permanently upgraded with data from the science. Traders, the food producing- and processing companies are as well beneficiaries as banks and insurance companies (why should not banks support to run an advisory concept? It would help them to use their rural area branch offices better) or also the producers of machinery or agro-chemicals. Foresters, land managers, utility managers or environment- and risk experts will also benefit from such an intelligent maintained system. Even telecom companies could support them to be able to run their new services also in rural areas – they are needed there.

22. BENEFITS IN DETAIL

Not all benefits can be listed but some of them show already the power of an integrated system:

- GIS gives detailed size of the fields as base for exact calculation
- GIS gives exact location of the field for later logistics use
- Farm management allows with underlaying expert data planning and documentation
- Farm management as a tool supports e.g. GLOBALGAP´s documentation needs
- Farm management allows nutrient- and CO_2-balance and is a subsidy tool if needed
- Farm management allows calculations (cost, contribution margin etc.) of fields/farms
- Farm management gives access to traceability (§§) and documents sustainability (§§)
- Farm management and GIS allow the development of modern advisory services
- Logistic and mobile GIS tools allow detailed logistic planning of complete regions
- Logistic and mobile GIS tools serve farmers, food industries and contractors
- Meteorology-data integration allows better decisions – just in times of climate change
- More benefit comes from business for banks or information for insurance companies
- Machine interfaces (ISO- or CAN-BUS) allow integration of precision farming
- Group solutions allow statistical analysis for regions or even countries
- Upgrade with forestry (forest inventory and forest management or forest logistics)
- Environmental caretaking solutions allow even farmers integration into this topic
- Risk management solutions allow also farmers integration in risk management
- Banks and insurance integration gives a win-win situation also for farmers
- A trust centre allows the integration of different users of agro-information
- An open space notary´s office will give benefits to ground owners resp. farmers
- ICT will support the fast distributing of ne scientific know how, an organized feedback will allow to verify and optimize results over the time!

23. VISIONS FOR TOMORROW

A Russian scientist named Kondratieff discovered, when several new sectors come together, they might boom and give a new growth wave. After 5 so called Kondratieff waves (steam engine and cotton, steel and railway, chemistry and electrical engineering, petro-chemistry and automobile and 5th the information technology) everybody asks: “What is the sixth wave?” Four sectors are in the pole position: informatics again, biotechnology, agriculture/forestry and environment- and risk-management. In the centre is the human being worldwide in a globalized world with his demands of providing healthy living- and working-conditions as well as satisfying his intellectual requirements and also taking care in a sustainable manner of the limited resources of our planet Earth. This is agreed with the Kondratieff expert and author of the book “The 6th Kondratieff”, Mr. Leo A. Nefiodov.

I am sure that the next wave will include agriculture, forestry and environment- and nature-based-risk-management. Why? Big parts of environment are linked to agriculture and forestry that covers big parts of our Earth, 50% of the health is coming from good food and clean environment, biotechnology shows also to agro-forestry and last but not least informatics – I think that with the above ICT solutions I could show some of the urgent needs and solutions for the future.

What is fiction, what is available today? ALL of the mentioned applications and technologies are available today, they wait that the farmers and foresters accept the challenge and start using it, for the many benefits they produce!