Agrisoft Systems
NEWSLETTER
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Message from the Management

Opportunities with SQL Server

Dear Customers and Friends,

In the past months, the Agrisoft Systems development team has started working on our long-planned migration of the OMP back-end database to SQL Server. From a user's perspective, the move to a different database might seem like a purely technical thing, because in itself it does not immediately add or change the features of the OMP application. However, the more powerful capabilities of SQL Server do actually open up many exciting possibilities for future development that I would like to take a brief look at.

The most obvious direct advantage of moving to SQL Server from the current Access-based backend is the simple fact that SQL Server is capable of handling far larger datasets efficiently. More precisely, Microsoft Access is limited to an overall file size of 2 GB whereas SQL Server offers different configurations that can be scaled up almost without limit, given suitable hardware. Improved data collection techniques with modern technology such as smartphone apps like OMP Field Survey, drones, automatic sensors etc. mean that it is now feasible to regularly collect much larger volumes of data than even a few years ago. An average OMP-using plantation of about 5,000 ha carrying out regular pest and disease, black bunch count and field upkeep surveys as well as daily production data recording can easily add thousands of new records a day to the OMP database. This volume will only increase in the coming years when data collection and analysis on a palm-by-palm level will become commonplace. With the migration to SQL Server, we have made the necessary step to be able to cope with these increased data volumes in the future.

The migration to SQL Server will help to improve accessibility to the data. One aspect is that many third-party applications can connect more easily to SQL Server than to Access data files. This can be useful in particular for multi-platform business intelligence applications such as PowerBI. Furthermore, SQL Server can be used to host data for a web reporting interface, for example via the so-called Reporting Services. This opens up possibilities of making the most important OMP reports accessible over the web in a platform-independent manner, so that e.g. managers could quickly pull down the most important reports on their smartphone. Of course, this requires a suitable data hosting set up with an OMP web-server accessible via public internet connections.

Another advantage of SQL Server is that it is far more suited to the challenges of running OMP as a multi-user application. In large scale oil palm plantations it is clear that the OMP data must be shared and made available to many users, and that data may also be edited by different users at different locations. This means that a central server (or at least a central file repository for data files) is required, which can be accessed by all users. In this context, one of the biggest challenges for us is the fact that due to unreliable network infrastructure OMP must be capable of

Message from the Management

running as an “occasionally-connected application”. This means that we cannot rely on users having a perpetual connection to the central server. Instead, it should be possible for users to work with OMP and edit data on their local machine and then synchronize with the central server as required. SQL Server includes various components and features which can help in this regard, and we are excited to explore the new possibilities.

The last big topic I would like to mention here is “machine learning”. Machine learning is a form of artificial intelligence in which large data sets are scanned and analyzed by a computer algorithm, in order to build a model that can be used to predict future outcomes. SQL Server provides support for some of the most important languages and frameworks used for modern machine learning approaches, and as described above is also capable of storing the required large data sets. Machine learning is ideally suited to complex systems such as oil palm plantations, in which there are many different factors which can affect output parameters. This complexity makes it hard or almost impossible for humans to manually build universally valid explicit models or equations to describe and predict future evolution. The exciting possibilities of such approaches are almost limitless. To name just two obvious examples, one could try to predict yield responses to various factors (e.g. climatic changes or pest events), or one could predict palm responses to different fertilizer inputs.

As you can imagine, the data migration itself is a lot of work and offers many technical challenges. As with any significant migration of this type, it is difficult to predict where problems may appear, especially as we as a team have to familiarize ourselves with the differences between SQL Server and our “conventional” Access coding techniques. The topics mentioned in this article are not meant to be a list of planned additions for the next release – but as you can see there are fascinating possibilities and we are excited to explore the possibilities of how we can use the new features to improve and add to OMP.

Yours sincerely,

Max Kerstan

Agrisoft Systems
NEWSLETTER
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Feature

Monitoring fertilizer application with OMP

Thomas Fairhurst[1] and Max Kerstan[2]

For most managers and owners of oil palm plantations, fertilization is high up on the list of most important topics when aiming to increase productivity and profitability. The reasons for this are fairly obvious, with fertilizers playing a crucial role in achieving high yields on typical soils while at the same time accounting for the majority of the variable costs of production [1].

The general problem of maintaining good palm nutrition can be broken down into two rather separate sub-problems. First of all, it is necessary to decide how much and which types of fertilizer to apply to each block. Due to the long lifespan of oil palms and the large areas under cultivation, there is often significant in-field variability in the nutrient requirements, so that a generic 'blanket approach' to recommendations is not favoured. There is no fixed universally accepted algorithm for the best way to calculate fertilizer requirements, but almost all approaches rely on evaluating relevant field data for each block. Depending on the approach used, the formulae or application rules typically take into account data on leaf and rachis nutrient levels but may also use various other supporting data including the results of factorial fertilizer experiments, soil analysis results, vegetative growth data, production data and field upkeep scores. Generating, analysing and modifying a set of fertilizer recommendations is not a trivial exercise, but with the OMP Fertilizer Planner the OMP suite contains a powerful application custom-built to help with this task.

Due to the fact that fertilizer recommendations affect the size and distribution of fertilization budgets, often counted in millions of dollars, a lot of attention is often focussed on generating the best possible fertilizer recommendations. As there is no standardized universal algorithm, the algorithm used is often a hotly debated topic. However, it is very important to keep in mind that having the right fertilizer recommendations is only half the job: it is at least as important to ensure that fertilizer is really being applied in the field in the correct manner following the agreed doses. Otherwise, falling leaf nutrient levels may only reflect incorrect application of previous recommendations rather than problems with the recommendations themselves. Plantation and field managers must ensure that the correct amounts of fertilizer have been ordered and de-

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Feature

livered on time, and that sufficient storage, transportation and labour capacities are available to carry out the fertilizer application as recommended. This, in particular, means that timing of fertilizer application must be planned appropriately, possibly to avoid peak crop months (where there is typically a shortage of labour) and to take into account climate effects (avoiding excessively wet and/or dry months depending on the fertilizer to be applied). As most fertilizer application in oil palm plantations is still carried out by hand, field workers must also be given clear instructions regarding the fertilizer doses to be applied per palm, calibrated cups to measure fertilizer for each palm, and how and where each type of fertilizer is to be spread. Finally, field managers should carry out checks of randomly selected blocks after fertilizer application to confirm that the tasks were carried out correctly and according to standard operating procedures.

OMP contains a set of features to support the entire process from start to finish. As already mentioned above, the OMP Fertilizer Planner application provides a powerful tool for generating fertilizer recommendations by setting nutrient target application rates for each block, based on available data in OMP, and then optimizing the fertilizer amounts to meet nutrient targets and minimize costs. Once recommendations are finalized, OMP contains a number of reports and forms which can be used to view the recommendations in tonnes at different spatial levels ranging from block to estate (Figure 1). These reports are particularly useful at the start of the year for managers to place fertilizer orders with suppliers and to plan for storage, transportation and labor requirements over the year.

At the start of each month, field managers should review in detail which fertilizers they need to apply in the given month and to which blocks. OMP contains dedicated reports with the relevant information that can be printed out and distributed to field managers or even field workers. For example, the report shown in Figure 2 displays all the relevant information for field managers and field staff, including a list of blocks

OMP Report – Monthly fertilizer recommendations by division　DEMO

No filter active.

Year: 2017　**Agrisoft Demo Estate**

Division: Center D01

Fertilizer group	Fertilizer	Application method	Total	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
								Inorganic fertilizer recommended [t]							
N - Source	Urea		519	4	1	1	0	163	1	1	211	5	1	132	0
	Urea	Man	14	0	0	0	0	4	0	0	6	0	0	4	0
P - Source	RP		179	0	0	0	0	0	0	0	0	0	0	0	179
	RP	Man	6	0	0	0	0	0	0	0	0	0	0	0	6
	RP-LCP		6	3	1	2	0	0	0	0	0	0	0	0	0
	TSP		75	2	0	0	0	5	1	1	0	7	1	3	55
K - Source	KCL		655	4	159	0	235	7	1	3	0	9	234	3	0
Others	Borate		42	0	0	40	0	0	0	0	0	1	0	0	0
	Kieserite		152	145	0	0	0	2	1	1	0	4	0	0	0
	Kieserite	Man	4	4	0	0	0	0	0	0	0	0	0	0	0
								Organic fertilizer recommended [t]							
Crop residues	EFB		3,480	0	2,784	0	696	0	0	0	0	0	0	0	0
	EFB	Man	0	0	0	0	0	0	0	0	0	0	0	0	0
	EFB	Mech	1,130	0	0	0	0	1,130	0	0	0	0	0	0	0

Figure 1: Monthly fertilizer requirements in tons

Feature

which need to be fertilized in the current month, the application dosage in kg/p and the number of bags of fertilizer required for each block. As an aside, it is important that the fertilizer recommendations are formulated in such a way that they are 'easy' for field staff to apply. In practice this means that per-palm recommendations should be multiples of a certain fixed cup size, so that workers only need to ensure that they have applied the correct number of cups at each palm. For example, the recommendations in Figure 2 have kg/p values that are multiples of 0.5 kg/p, so it would be easy for workers to fulfil them using 0.5 kg cups. In particular, it makes little practical sense to try to calculate fertilizer recommendations 'to the last gramme' using overly complicated formulae when the input data such as leaf analysis results typically have limited accuracy and the results must anyway be rounded into practical steps at the end. Rounding according to user-defined cup sizes is automatically built-in when using the OMP Fertilizer Planner.

Field managers or work team supervisors should carefully record where fertilizer application was carried out. For example, the report shown in Figure 2 could be printed and then each row could be signed off with a date and information on the number of bags used. Alternatively, OMP provides a dedicated data collection report shown in Figure 3 that displays the recommendations for each month and provides space to fill in the actual applied amounts as the work is carried out.

Printed out at the start of the year and pinned up in field offices, this kind of report provides a useful overview of the fertilizer programme that

OMP Report – Fertilization recommendations in month by block DEMO

No filter active.

Month: October 2017 — **Agrisoft Demo Estate**
Fertilizer: KCL — **Application method:**

Block		Area ha	# Palms	Recommendation kg/p	t	bags
Estate:					**1835.1**	**36,702**
Division:	**Center D01**				**234.4**	**4,688**
Field:					**1.1**	**23**
322A		7.95	1,128	1.00	1.1	23
Field:	**MT04**				**27.6**	**553**
302E		37.13	4,788	1.50	7.2	144
303A		43.46	5,563	1.50	8.3	167
305A		22.92	2,959	1.50	4.4	89
315B		12.96	1,711	1.50	2.6	51
315D		10.05	1,426	1.50	2.1	43
315E		4.28	606	1.50	0.9	18
316H		9.65	1,369	1.50	2.1	41

Figure 2: Monthly fertilizer recommendation report by block

Feature

OMP Data Collection – Fertilizer programme

No filter active.

Fertilizer: KCL
Application method:

Block		Jan		Feb		Mar		Apr		May	
	Unit	kg/p	bags	kg/p	bags	kg/p	bags	kg/p	bags	kg/p	bags
Division: Center D01											
301B	Rec.	0.00	0	1.00	98	0.00	0	1.50	147	0.00	0
	Act.										
301C	Rec.	0.00	0	1.00	87	0.00	0	1.50	130	0.00	0
	Act.										
301D	Rec.	0.00	0	1.00	72	0.00	0	1.50	108	0.00	0
	Act.										
301F	Rec.	0.00	0	1.00	71	0.00	0	1.50	106	0.00	0
	Act.										

Figure 3: OMP Fertilizer data collection report

is scheduled for the coming months as well as a developing record of what has already been applied during the year. The data on the actual fertilizer application must be entered into the OMP database at the latest at the end of every month. At higher management levels, for example for division and estate managers who are responsible for thousands of hectares, sifting through detailed block-level reports can be tedious. However, OMP provides suitable tools also to reconcile actual fertilizer application with recommendations at all spatial levels. Data analysis forms such as the form shown in Figure 4 show the data of the selected month as well as the accumulated year to date values and also allow for filtering and sorting directly on the form. This is a very powerful feature as it makes it easy to directly focus on those blocks where fertilizer application is running behind recommendations, allowing management to take suitable corrective action.

Finally, it is usually good practice to carry out randomized checks in blocks in which fertilization has been reported as 'completed', to ensure that everything was carried out correctly. The OMP Field Survey app is ideally suited to this, as it allows managers to define a suitable survey type and then easily record data using their smartphone as they walk through and inspect a block. Typical things to look at might include whether fertilizer was really applied in the whole block (especially in remote, hard-to reach sections far from roads), whether the correct amounts were applied as recommended and whether the fertilizer was applied in the correct place. Figure 5 shows a simple OMP-FS survey with yes/no questions, but additional survey questions can be defined using more detailed scoring if desired. With OMP-FS, data surveyed in the field using the smartphone can be geocoded,

Fertilizer application

Month: 10 2017 ☐ Show application method

Inorganic: Estate | Division | Field | Block | Organic: Estate | Division | Field | Block

Division	Field	Block	Fertilizer		October			Year to date		
					bags	t	kg/p	bags	t	kg/p
Center D01		322A	TSP	Act.	0	0.0	0.00	0	0.0	0.00
				Rec.	23	1.1	1.00	34	1.7	1.50
				Diff. (Act.-Rec.)	-23	-1.1	-1.00	-34	-1.7	-1.50
Center D01		322A	Urea	Act.	11	0.6	0.51	34	1.7	1.50
				Rec.	11	0.6	0.50	34	1.7	1.50
				Diff. (Act.-Rec.)	0	0.0	0.01	0	0.0	0.00
Center D01		345A	Borate	Act.	0	0.0	0.00	5	0.3	0.10
				Rec.	0	0.0	0.00	5	0.3	0.10
				Diff. (Act.-Rec.)	0	0.0	0.00	0	0.0	0.00
Center D01		345A	KCL	Act.	0	0.0	0.00	53	2.6	1.01
				Rec.	0	0.0	0.00	52	2.6	1.00
				Diff. (Act.-Rec.)	0	0.0	0.00	0	0.0	0.01

Figure 4: Fertilizer reconciliation form

Feature

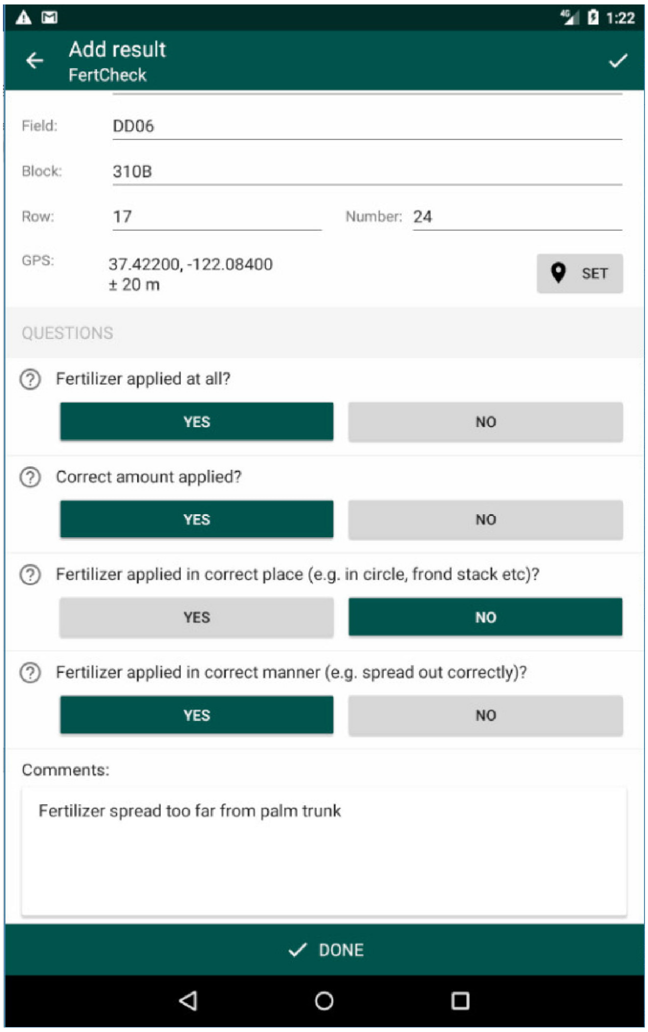

Figure 5: Sample survey in OMP Field Survey to check fertilization

and data collected at individual points in a block is automatically summarized and aggregated to block level and above. It is furthermore easy do define 'thresholds' for acceptable limits of any kind of aggregated results, in order to more easily focus on 'offender' blocks where thresholds have been violated. In the sample survey of Figure 5, it would for example be possible to count a block as an 'offender' if there was no fertilizer applied at all in 2% or more of surveyed points in the block, or if the fertilizer amount was incorrect in 5% or more of surveyed points in the block. If desired, point survey data can be exported to a mapping software such as MapInfo or ArcGIS to provide point maps of locations where incorrect fertilization was found.

As outlined in this article, fertilization is one of the most critical topics for oil palm plantations and the challenge does not only consist of devising suitable fertilizer recommendations. Instead, it is equally important to ensure that fertilizer is applied correctly in the field (the Four Rs: the right fertilizer in the right quantity at the right time in the right place), and that problems are spotted swiftly so that management can arrange corrective action. OMP provides a wide range of tools to help with every step in the process – make sure you harness the full power of these tools to ensure you are getting the best value for money out of your costly fertilizer purchases.

[1] Fairhurst, T., Kerstan, M. and Memenga, N. (2015) Use of a 'glass-box' computerized decision support tool (CDST) for the preparation of fertilizer recommendations in oil palm plantations, http://www.agrisoft-systems.com/wp-content/uploads/Papers/BCFertPlanner20150909v1_1s.pdf

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NEWSLETTER
Jul.— Oct. 2018

From the developers desk

A selection of the on-going developments and plans which are part of our constant efforts to continue to improve Agrisoft products.

OMP Field Survey improvements

- Add support for iOS smartphones and tablets
- Option for NFC chip scanning in addition to QR
- Free text entry questions
- Add point type „palm row“
- Implement templates for survey types/ questions which can be exported/ imported between different OMP installations
- Allow using the survey date in expressions, allow expression data type date

OMP data analysis features

- Better analysis of historical production by land class, to review yield potentials
- Active filtering instead of reloading on activate for more responsive program
- Arbitrary number of series on yield by age and parameter chart
- Additional subgrouping options for monthly/YTD yield chart
- Additional fertilizer relative agronomic effectiveness (RAE) field for Nitrogen
- More details on vegetative growth data analysis forms

OMP update process

- Better way of applying version updates to data files, with no need for manually importing data from the previous version
- User configuration settings saved in config files so that settings are not lost when updating OMP