Playing with Real-life numbers in Farming Simulator

Version 1.2.3.9 (adapted to Seasons and Precision Farming)

By

ArmChairFarming

Preface

The most significant new feature in Farming Simulator 19 is the ability to design and build your own farmyard. A feature that more than any will facilitate and encourage individualization of the game, allowing players to build their farm either from pure fantasy or based on a real-life farm in their own neighborhood.

The present mod, **RealLifeNumbers by ArmChairFarming**, aims to allow further individualization of the game by providing easy access to key game parameters. The first objective of the model is to use real-life parameter values for various aspects of the game, including both arable farming and husbandry. Such real-life parameters are taken from official statistical services in the European Union (EU) and the United States Department of Agriculture (USDA). Over time, different versions will be published covering different member-countries in the EU and different USDA regions in the US.

This note aims to provide some background information on the series of scripts included in the mod, what parameters they alter, and what approach lies behind their new definition.

The mod differs from other mods in that the user must edit the mod to fit the mod to the game style and farm plan the user attempts to implement. This editing is done in between game play, and, particularly during the initial phase of a new game, when the farm is being designed and necessary plans need to be made to create a harmonious balance between the size of the husbandry and the size of the farmland.

The mod consists of a series of scripts each covering different areas. The mod offers very little visual interaction with the player. The mod scripts redefine Game parameters during game start up, and a very large number of defined and derived values are printed to the log file.

Finally, a brief note on the author of the mod. My name is Kaj-Åge “Ki” Henneberg. I’m a professor of engineering and teach mathematical modeling to engineering students. My only real-life experience with farming is my childhood life on my parent’s small farm in the western part of Denmark in the 1960-1970. We had lots of pigs, barley and potato, a David Brown 880, a Farmall D-320, and about 50 acres of very sandy fields. My brother and I had our daily chores, mugging out the pigs was one of them, ploughing and cultivating were some in the fun end of the scale.

This is the first ever mod made by this author. The features as well as the programming style certainly reflect this very clearly. Starting with no knowledge of the data structure of Farming Simulator and no knowledge about Lua programming, the progress was very slow in the beginning. The mod uses scripts and will therefore not work on consoles. The mod is not written for multiplayer mode but reports from multiplayer users indicate that locally hosted multiplayer mode is possible to some degree. Multiplayer games on dedicated servers most likely will not work at all.

Who is **ArmChairFarming**? Just me. The expression “Armchair farming” was to my knowledge first used by George Saunders, a real-life British farmer and YouTube author, while comparing driving his much loved JCB 4220 in real-life and in FS17. Thank you, George, for letting me use it.

While enjoying immensely playing Farming Simulator, we all need external inspiration once in a while. This I get by watching YouTube videos from real-life farmers (George Saunders, Tom Pemberton, CowFarmerDan, MN Millenial Farmer, How Farms Work, Cole the Cornstar, Larson

Farms) as well as from game players and mod reviewers (Daggerwin, MrSealyP, Farmer Klein, Nick The Hick). Thank you all for teaching and inspiring me.

My final thank-you goes to all the hard core modders and mappers, who's complex codes make me feel like a newborn baby.

The redefined sell prices will only have their correct values when the economic difficulty level is set to HARD. Changing the economic difficulty level to Normal will scale the sell prices upward by a factor 1.8 and the Easy level will scale by a factor 3.

A second factor that can cause crop sell prices to deviate from the levels preset by the mod is if the map designer has implemented price-scaling at the sell points on the map. Some map designers do this systematically. To investigate if this is the case, you will need to unzip the map and inspect the xml files of each sell point in the placeables folder. Look out for the **pricescale** parameter. If different from one, the sell point is scaling the sell price. The same situation applies to user placeable sell points. It is a quickly mastered process of unzipping, editing and rezipping such maps and mods. I use the freeware program 7-ZIP to unzip and rezip files. Just remember, that the rezipped file should have the extension "zip", NOT "7z". **I use the freeware editor Notepad++ to edit files**. I recommend you do not edit mods while they are inside the FS19 mod folder. For this purpose, I have a series of folders: mods-unused, mods-edited, mods-conflicts, and so on.

A third factor to consider is the highly overexaggerated price variation built into FS19, causing price differences between sell points on the order of 100%. The mod attempts to reduce this variation, but it is hard to tell if the attempt has any effect.

Yours truly,

Kaj-Åge Henneberg
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Farum, Denmark

Figure 1. What lies ahead?

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1 Introduction

The mod **RealLifeNumbers** redefines the numerical values of a range of game parameters toward real-life values within a well-defined geographical region, either a country in the European Union (EU) or an agricultural region in the US as defined by the United States Department of Agriculture (USDA).

1.1 Objectives of the mod

The mod has three main objectives:

1. To define a game environment mimicking real-life farming in a well-defined area.
2. To enable players to individualize the game using a simple editor.
3. To provide a game planning tool for the player.

Ad 1) As time goes, maps will be available presenting farming in many different countries and within very different climatic environments. Farming thus is very different in different areas of the world, different crops are grown, different harvest yields are seen, and prices on crop, farm supplies, animals, milk, wool, farmland, etc. vary significantly. The first version (v. 1.0.0.1) of this mod contained real-life numbers for Germany, as I was playing on the maps Felsbrunn by Giants and Oberlausitz by RitchiF. Now there are flavors of the mod with data for the UK and US. All flavors are multifruit-ready.

Ad 2) There is only one right way of playing Farming Simulator: Your way. Whether you play the career game, building up a farm from scratch while fighting economic hardship with a 2-furrow plough or play a real-life simulation game, there is a need to tweak the game toward your personal playing style. While the mod aims to setup a real-life framework, it can easily be made to meet other personal game styles.

Ad 3) If your preferred style of playing is to do real-life simulation of farming in a specific geographical region, you need not only to redefine game parameters, you need also to do a pre-game setup, where you establish a good model of the farm you want to simulate. It is a real scoop for this game style, that FS19 now allows you to build your own farmyard. But many questions arise: How much land do I own? How many animals can I have if I have this much land? Can I afford buying more land or should I rent? What crop and how many hectares are needed to feed the animals? How many bales do I need of straw and grass? Do I have surplus crop for selling? What crop gives the highest income per hectare in my area? How much seed is needed? Should I lease rather than buy equipment? How much milk, wool, egg, manure and slurry do my animals produce? How much nutrient is in my organic fertilizer? How fast will my animal stock reproduce? What if I just want to rear fattening pigs? RealLifeNumbers provides the numbers and means you need to answer all these questions and more.

Seasons: The mod has some overlap with the Seasons mod by Realimus Modding. Consequently version 1.1.4.0 does not run with Seasons activated. All versions of RealLifeNumbers with a version number higher than 1.1.4.0 will strive to be compatible with Seasons. Version 1.2.0.0 will be the first Seasons compatible version of RealLifeNumbers. Version 1.2.0.0 is a reduced version of RealLifeNumbers, where animal care features have been removed in favor of the much stronger model introduced in Seasons. In version 1.2.2.0 a new predictive model has been introduced providing useful information for planning and building your farm.

1.2 Who is this mod for?

A real-life simulation game is entirely different from a career game in how you measure success and how you judge the means to reach your objective. In a career game, the framework is a predefined set of conditions and the way you act to resolve all the different challenges are also governed by a set of implicit rules. In a real-life simulation game, the initial setup phase is a design phase, where you in a very direct way establish the farming environment, you want to create. Only when this is accomplished does the game begin. In the setup phase, you will need to add money to your bank account repeatedly using a money cheat mod to buy/rent fields, level grounds, build your farm, and acquire starting animals and equipment as well as feed and farm supplies. This is an established farm, not a new farm, so there is already plenty of slurry in the pit and bales in the hayloft.

Some will say that this style of play is too easy. But planning a farm requires lot of knowledge and information about farming. RealLifeNumbers will make it easier by providing lots of needed information. Still, if you don't like to use a money cheat mod, you can make use of loans and make use of the mod features to lease land and equipment instead of buying.

Do not activate this mod, if you are in the middle of a career achievement game. The mod will change many economic parameters, and the economic achievements in your career game will take a different direction than what you started out with. If you want to use the mod, do it in a game, where your previous economic achievements are considered of minor relevance.

Deinstalling the mod will not bring back the original game parameter values. To obtain the original game parameter values you will need to reinstall the map. This can be done without interfering with your save game.

I strongly recommend that users of the mod make a back-up copy of the save game folder for the map they want to play before activating this mod.

1.3 The components of the original mod (version 1.0.0.1)

RealLifeNumbers has a modular structure in the sense that several separate scripts are called in the order defined in modDESC.xml. The following scripts are activated by default:

- `RealNumbersInitialization.lua`
- `RealNumbersCropYield.lua`
- `RealNumbersGreenCropYield.lua`
- `RealNumbersSpraying.lua`
- `RealNumbersSeedUsage.lua`
- `RealNumbersCropPrices.lua`
- `RealNumbersCommodityPrices.lua`
- `RealNumbersLeasing.lua`
- `RealNumbersAnimalProducts.lua`
- `RealNumbersAnimalCare.lua`
- `RealNumbersAnimalTradePrices.lua`
- `RealNumbersFieldInfo.lua`
- `RealNumbersContracts.lua`

The purpose of each script will be explained in the following sections.

1.4 The components of the previous mod (version 1.1.4.0)

This version has been updated to accommodate maps with an extended set of fruits (multifruit maps). This has required a complete redesign of how the mod reads game parameters. During the redesign of scripts, some scripts have been merged into one, and some features have been dropped in favor of new ones.

- `RealNumbersInitialization.lua`
- `RealNumbersCropYield.lua`
- `RealNumbersSpraying.lua`
- `RealNumbersCommodityPrices.lua`
- `RealNumbersLeasing.lua`
- `RealNumbersAnimalProducts.lua`
- `RealNumbersAnimalCare.lua`
- `RealNumbersAnimalTradePrices.lua`
- `RealNumbersFieldInfo.lua`
- `RealNumbersFarmland.lua`
- `RealNumbersContracts.lua`
- `RealNumbersVehicleMaintenance.lua`

The first script **RealNumbersInitialization** contains all the game parameters accessible for redefinition by the mod user. The original parameter values are obtained from statistical services and represent a specific country or agricultural region (US). The mod user is of course free to change the values as desired. In some cases, local values are unknown and representative values are taken from elsewhere, typically an average value in the European Union (EU) or from the US department of agriculture (USDA). In the script **RealNumbersInitialization**, parameters with geographical dependency have been marked “GEO” in the comment, followed by an indication of the country for which this value is valid. If an EU or US average is used, it will say “GEO EU” or “GEO US”. There are also parameters for which it is very difficult to get values. One such value is the price of seeds. Such parameters have been assigned a “reasonable” value and is marked “GEO COM”, as it is a value used commonly in all national versions of the mod.

RealNumbersCropYield has been completely rewritten and now combines the definition of crop yield with definition of seed usage and crop sell prices. The consequence is that the log report provides all this information sorted by crop types.

1.5 Version 1.2.0.0 (Seasons Ready)

The Seasons mod by Realimus Modelling offers a number of changes to the game that will create conflicts with version 1.1.4 of FS19_RealLifeNumbers. Two of the most significant changes are the models for growth of crops and the model for growth of animals. The growth pattern for crops is now influenced by the climate conditions. This means that the time for seeding and harvesting now are influenced by soil temperature and other climate factors. Therefore, version 1.2.0.0 of FS19_RealLifeNumbers will no longer make use of the time duration for crop growth phases. The mod parameter RN.growthDays.CROP is still present in the script, but not used.

With Seasons 2019, the animals follow a real-life growth curve, and feed intake and waste output will be a function of the current weight of the animal. This is a huge step forward in sophistication and the updated version of FS19_RealLifeNumbers will embrace this completely.

- `RealNumbersInitialization.lua`
- `RealNumbersCropYield.lua (lAlt-ry)`
- `RealNumbersSpraying.lua (lAlt-ru)`
- `RealNumbersCommodityPrices.lua`
- `RealNumbersLeasing.lua`
- `RealNumbersAnimalProducts.lua`
- `RealNumbersAnimalCareSeasons.lua`
- `RealNumbersFieldInfo.lua (lAlt-rf)`
- `RealNumbersFarmland.lua (lAlt-rt)`
- `RealNumbersContracts.lua (lAlt-rc)`

1.6 Recent additions, corrections and issues

As of version 1.2.3.9 the mod contains the following scripts:

- `RealNumbersInitialization.lua (lAlt-rh)`
- `RealNumbersFruitInfo.lua (lAlt-rn)`
- `RealNumbersForageCrops.lua`
- `RealNumbersCropYield.lua`
- `RealNumbersForestry.lua (lAlt-rq)`
- `RealNumbersMyFieldCrops.lua`
- `RealNumbersEquipmentEconomy.lua (lAlt-re)`
- `RealNumbersBalingEquipmentEconomy.lua`
- `RealNumbersPrecisionSpraying.lua (lAlt-ru)`
- `RealNumbersCommodityPrices.lua (lAlt-ra)`
- `RealNumbersSeeding.lua (lAlt-ro)`
- `RealNumbersCropProductionCost.lua (lAlt-ry)`
- `RealNumbersForageProductionCost.lua (lAlt-rb)`
- `RealNumbersLeasing.lua`
- `RealNumbersAnimalProducts.lua`
- `RealNumbersAnimalCareSeasons.lua`
- `RealNumbersAnnualFeedPrediction.lua (lAlt-rz)`
- `RealNumbersFieldInfo.lua (lAlt-rf, lAlt-rg, lAlt-rd))`
- `RealNumbersFarmland.lua (lAlt-rt)`
- `RealNumbersContracts.lua (lAlt-rc)`
- `RealNumbersSellingStations.lua`
- `RealNumbersEnvironments.lua (lAlt-rw)`

Version 1.2.3.9

A few filltypes and fruittypes have been added so the mod is compatible with more maps. This version of the mod has been played without issues on the maps:

- Chellington Valley 1.0
- Hof Bergman 1.0.0.7
- Rustic Acres 4.0

- Griffin Indiana 19

A detailed test has not been completed as this would take months.

Precision Farming

The mod does not alter parameters in the Precision Farming mod. Personally, I change some parameters within the mod itself. More detail is given in a later section.

Fixes

In version 1.2.8.0, the mod would not count animals of the same type in more than one stable. If one had cows, in two places, it would only count in the latter of the two. This has been fixed.

Version 1.2.3.8

A few adaptations to new mods have been included.

RealisticSeeder. This mod by Ifko[nator] changes the seeding approach so that you need a specific seed type matching the crop. These crop specific seeds are bought on pallets. In RealLifeNumbers a few adjustments are made to the volume of the pallets. Default volume is 2100 L, but in this case a pallet of sugarbeet seed will cost more than 100,000 €. RealLifeNumbers calculates how much seed is needed for a certain number of hectares and then defines the pallet volume of each seed type to match this amount. Some crops need very little seed and others a lot more, so the volume of the seed pallets vary considerably. The default pallet amount meets the seed amount for about 3 hectares. So, you will need one seed pallet for every 3 hectares you want to seed. The user can change the number of hectares. The price of the seed pallet reflects the volume and the unit price of the seed. Another slight modification done in RealLifeNumbers is that you can return the unused seed and receive a refund.

Extra animals. Some maps now have goats, calves, piglets and ducks. I believe this addition is developed by Farmer Andy. RealLifeNumbers has been extended to provide the same information for these new animals as for the standard animals. The way these new animal types are added to a map varies. On HOF Bergman by Farmer Andy, goats have animal type SHEEP. I believe this may be in order for the goats to share pen with sheep. When RealLifeNumbers counts animals, goats will then be included in the number of sheep. The same approach is used with ducks. On Rustic Acres 4 by cazz64, goats and ducks have their own animal type and their own pens. In this case RealLifeNumbers makes a correct count of all animal types. RealLifeNumbers predicts the feed needed and hectares of fields needed for each feed crop. This is done for all types of animals, except horses, chickens and ducks. The amount of feed consumed by these animals is here considered marginal and not essential in the assessment of land need.

Field work cost. The equipment economy prediction model added in version 1.2.3.6 has been extended to show a more detailed listing of field work expenses. This can help pinpointing where to cut cost in field work. To facilitate this, new input parameters have been added to each fruit type in **RealNumbersInitialization.lua** to set the number and types of field jobs done in one growth season. These numbers have no effect on the game but are used to predict the cost of field work. A more extensive list of field jobs per crop type is presented in the script **RealNumbersMyFieldCrops.lua**.

A few issues have been corrected regarding different types of pallets.

Version 1.2.3.7

Fixed issues with HOF Bergman fruittypes.

New Forestry script allows scaling of the price of tree logs for 11 varieties of trees.

The calculation of egg prices is now based on net volume of eggs instead of egg box volume.

Version 1.2.3.6

An intermediate release fixing a problem with cotton bales.

An economic prediction model has been added to help determine whether it is best to own equipment or to hire a contractor.

Version 1.2.3.5

This an intermediate release fixing a few issues.

Version 1.2.3.0

Version 1.1.0.0 of Seasons introduced snow contracts. This was an undefined contract type in RLN version 1.2.2.0 and could cause RLN to crash the game. Version 1.2.3.0 of RLN has added snow contracts and have also been modified to (hopefully) handle future undefined contract types more gracefully.

Version 1.2.2.0

The biggest update of this version is the reintroduction of a script for predicting feed amount, number of bales and field area to cover feed consumption of your animals. This feature was part of the mod before the appearance of Seasons 19 but had to be removed while making RealLifeNumbers compatible with Seasons 19. The script is described in a separate chapter.

Another change has to do with bale sizes. In version 1.2.1.0 bales sizes were readjusted to a predefined size. However, mod users have pointed out the importance of being able to work with a range of bale sizes in the same save game. The bale size is now calculated from the dimensions of the round bales and square bales. To change the volume of the default bales, you will need to change their size (diameter, width, length, height). Using the default sizes of bales, round bales are about 1500 L and square bales about 2600 L. Bales purchased in the store are 4000 L for both round and square bales. With this approach you can have small bales of 600 L, standard bales of 1500/2600 L, high density bales of 4000 L and Heston bales of 6000 L, all at the same time.

Some daily cost parameters have been adjusted. Vehicle Running Cost and Property Maintenance Cost are charged at the end of each game day. The mod now allows the user to adjust these costs by setting new mod parameter values. See more information in the section Commodity Prices.

Version 1.2.1.0

Random variation in crop yield has been cancelled in the default version. The reason for not including random yield in FS19_RealLifeNumbers is that the Seasons mod already creates a much more realistic yield variation due to weather conditions and crop rotation. It can easily be reactivated. In the script RealNumbersCropYield.lua set `randomness = 1` in line 132.

Following user requests, the approach to field renting has been redesigned. Using the seasonal calendar created by the Seasons mod, all field rent contracts are now terminated on the first day of mid-winter. It can be renewed, starting on following day. The termination day can be modified by the user. The rent price now automatically decreases based on how many game days are left until the rent termination day. Hence, if you only rent a field for half of the rent year, you will only pay half of the full year rent. On the rent termination day, the rent price is zero. You can rent fields on that day, but the contract is cancelled at no loss. If you rent a field in the first half of the rent year and later decide to cancel the rent contract, you will be reimbursed an amount corresponding to rent cost for the remainder of the rent-year. If you have seeded/planted winter crop on a rented field, you will not own the field on the rent termination day, however, you can renew the rent contract on the following day, and then carry on carrying for your crop.

Two types of issues have been reported on contracts/missions. The first is related to fertilizing contracts. Often it is impossible to complete a fertilizer contract, if the field has already been fertilized once. It is unclear what causes this issue. The same issue has been recognized by Realismus Modding, the author of the Seasons mod. To reduce the likelihood that FS19_RealLifeNumbers should be the cause of this issue, the script RealNumbersContracts.lua has been rewritten so that it no longer writes data to the mission parameter table but only reads values from this table. This has no consequence for how the mod user experience this script. Despite the changes, the issue remains.

Another issue with contracts relates to plow and cultivation missions. FS19_RealLifeNumbers normally writes the crop type associated with the field on which a contract is done. However, for plowing and cultivation contracts, the associated crop types are reset to undefined when the contract nears its completion, causing FS19_RealLifeNumbers to write error statements to the log file. This has been fixed simply by not writing a crop type to the log file for plow and cultivation contracts.

Version 1.2.0.0

Crop growth duration has been dropped.

Prediction of fertilizer amount has been adjusted to fit three fertilizing stages. Each application covers one third of the total needed application for the given fruit type.

Bales bought in the store are listed with their defined volume. For unknown reasons they spawn as 4000 L bales. This seems to have started with patch 1.4. An attempt has been made to correct this. The bales will not have the correct volume until the game is reloaded. This means that newly bought bales should be put in storage and not used until a later game play.

The whole script AnimalCare has been replaced by a new script AnimalCareSeasons. The new script allows the player to change parameters for feed intake and waste output, but not parameters for the growth model.

Seasons redefines the service interval for equipment. A similar script in FS19_RealLifeNumbers has therefore been removed. The user can change the service interval by changing that parameter in the Seasons mod.

This version of FS19_RealLifeNumbers does not offer information about how much feed and crop acreage is needed for a given herd. Such information should ideally be predicted from the Seasons models for animal growth and crop yield. There is currently no information available for modders to explain the model parameters, hence I believe a better approach is to develop a prediction model relying on statistical data from real life. I hope to be able to include this feature in a future version of the mod. (This information has been reintroduced in version 1.2.2.0).

Multiplayer mode

The mod was not initially intended for multiplayer mode because Giants does not make information available for making mods multiplayer ready. It turns out, that the mod is somewhat multiplayer capable, if a local host is used (not a dedicated server). To enhance the degree of multiplayer-readiness, a few modifications were tested in multiplayer mode using a host and client on the same local-area network. If a dedicated server is not used, a wide-area network should also work.

Certain game parameters can only be seen by the host. This applies in particular to the parameters worked on in the script **RealNumbersContracts**. Pressing lAlt-rc on the host will display both a general contracting pricelist but also itemized contracts for current contracting jobs. The host does not share this information with the clients; hence the itemized contracts are not printed out on client PCs. The client PC can still do the contract jobs and receive the correct reward, but an itemized contract is not printed.

1.7 How to use the mod

RealLifeNumbers does most of its job during game startup. User interaction with RealLifeNumbers is outside the game. If a mod user feels that the predefined numbers should be changed, this needs to be done using a simple editor. Notepad could be used, but Notepad++ is much better as it recognizes the lua syntax. To facilitate the recurrent interaction with the scripts, it is recommended to unzip a copy of the mod into a dedicated folder and keep this folder at all times. If a parameter value needs to be changed, open the specific script in Notepad++, make the change, save the script and make a new zip file with all the files in the folder. Then drag the new zip file to the folder with your mods and restart the game. This manual does not need to be inside the zip file when using the mod.

RealLifeNumbers prints all information to the log.txt file. The information is mixed with loading information from all other mods in the game. This seems a bit confusing, but as the user only needs this information occasionally, it is an easy one-time task to edit out irrelevant loading information using a text editor and thereby create a map specific report. For use in the game planning phase, this report can be printed out on paper or converted to a pdf file and displayed on a tablet conveniently located next to your game computer.

This simplistic style of user-mod interaction may seem too complicated or annoying to many players. If this is the case, I believe your game style will not benefit much from the mod and you will be better off not using the mod. Players who play the game as a real-life simulator are used to making records of harvest yields and other information in a small note book. Hopefully, this group of players will find the simplistic approach manageable.

It may be of some convenience to see the log file on the screen while playing the game. This can be done by editing `game.xml` located in the folder `Documents\My Games\FarmingSimulator2019`. In this file,

```
<development>
        <controls>false</controls>
</development>
```

should be changed to:

```
<development>
        <controls>true</controls>
 </development>
```

When starting the game, you may then press the key just below the Esc key on your keyboard. Whatever is written to the log file will also be copied to the screen, but unfortunately not in fixed-width font. By using the Page Up/Down keys, you can browse through the output from the mod to get a quick look at something without leaving the game. Pressing the button just below the Esc key two times more will make the text disappear from the screen and you can continue playing the game.

To ensure that the mod gives you the expected results, **you must play the game with Economic Difficulty set to HARD**. At normal economic level, prices will be scaled by 1.8, and at EASY, they will be scaled by 3. This scaling is done by FS19, not by this mod.

First time on a map? The mod reads files in the savegame folder. Hence for the mod to work as intended, you will need to save the game, exit, and then reenter the game the first time you play on a map.

1.8 Keyboard shortcuts

There are some keyboard shortcuts you will have to use to obtain some of the information produced by the mod. They are summarized in Table 1.

Table 1. Keyboard shortcuts. Hold down left -Alt while at the same time pressing the two letters.

lAlt-rh	:	This overview
lAlt-ra	:	Animal information
lAlt-rb	:	Bale information
lAlt-rc	:	Contract information
lAlt-rd	:	Game day information
lAlt-re	:	Economy information
lAlt-rf	:	Field information
lAlt-rg	:	Owned field information
lAlt-rn	:	Fruit information
lAlt-ro	:	Seed pallet information
lAlt-rq	:	Tree log information
lAlt-rt	:	Land information
lAlt-ru	:	Fertilize information
lAlt-ry	:	Yield information
lAlt-rw	:	Environment information
lAlt-rz	:	Feed mixture information

1.9 What if I find a mistake?

It is very likely a user will disagree with one or more parameter values set by the mod. If the value in question is a factor 10 off from the value you think it should be, then it is likely, that I or the data source have made an error, and I would be glad to hear about it. If you disagree because you live in a part of the world with unusually high milk or oat yield, then simply refit the parameter values to match your situation. After all, individualization is one of the main aims of the mod.

In the derivation of game parameters, I have used a range of methods. Some take root in factual information published by universities or farming organizations and others are just rules of thumb found on the internet. In the latter case there might be better methods and I would like to hear about them.

1.10 Coexistence with other mods

A range of good mods change some of the same parameters as redefined in this mod, such as crop yield, seed usage and prices on crops and farm supply. If used simultaneously with RealLifeNumbers, conflicts will arise as to what value the parameters will end up having. Most other mods with this issue have entirely different objectives, hence it should be of no consequence to simply disable these mods when using RealLifeNumbers.

I use three mods, which supports RealLifeNumbers particularly well, **variableSprayUsage** by monteur1, **VariableBaleCapacity** by sperrgebiet and **Seasons** by Realismus Modding.

variableSprayUsage by **monteur1** adjusts the running output rate of spreaders and sprayers according to the current driving speed. This mechanism prevents over/under-application of spray material in areas of the field with varying driving speed, such as at headlands an on very hilly fields. The user can set the spray rate in Liters/hectare. It is easy to edit the mod and extend the range of possible settings, so the mod can be set to deliver the spray rates calculated by the script **RealNumbersSpraying.** To assist this adjustment, **pressing left Alt-ru** will cause the script **RealNumbersSpraying** to print the pre-set spray rates in the log file (and on the screen if development is set to true in game.xml and the log file is made visible by pressing the key below the ESC key once).

VariableBaleCapacity by **sperrgebiet** allows you to calibrate balers to produce bales of different volumes. I use it to calibrate *round-balers to 1500 Liters and square-balers to 2600 Liters*. These numbers are not default numbers in the mod by sperrgebiet. You can either change the numbers inside the mod, or you can change the numbers in the XML file in the mod-settings folder. There is a version of this file for each save game. If this file exists, this value will be used, even if you have changed numbers inside the mod. I have changed the numbers both in the mod and in the XML file for each save game.

Table 2. Added bale sizes on line 21 in variableBaleCapacity.lua by sperrgebiet

```
--Set some defaults; 20k might seem odd, but it's required for cotton modules
VarBaleCap.Capacities = {1500,2600,4000,6000,8000,10000,20000}
```

From version 1.2.2.0, the volume of both round and square bales bought in the store are equal to the default in-game value of 4000 Liters.

Seasons by Realismus Modding. RealLifeNumbers have been adapted to work with Seasons. This means that RealLifeNumbers no longer sets parameters for animal and crop growth rate. RealLifeNumbers still allows the mod user to adjust a large number of crop and animal related parameters. I alter the workers fee in Seasons to be a realistic value. However, ***altering other mods may prevent you from playing in multiplayer mode***.

Table 3. Changes helper wages in Seasons. data\economy.xml.

```
<ai workdayStart="6" workdayEnd="18" workdayPay="16.50" overtimePay="24.75" />
```

MaizePlus/MaizePlus – forageExtension. These mods by The-Alien-Paul and Modelleicher, redefine the feed for animals and add more feed components. It complicates the feeding job, but I like it very much. RealLifeNumbers is now able to handle all the feed components added in MaizePlus.

Precision Farming. A fantastic addition that introduces soil Nitrogen and pH as factors in growth. You need to take soil samples for Precision Farming to do its work. When using this mod to determine the spray rate, the mod **variableSprayUsage** is not in effect.

Unfortunately, the prices for soil samples are much too high compared to real life. I change this in line 20 in the file PrecisionFarming.xml.

Table 4. Adjustment of price for soil sampling. In PrecisionFarming.xml.

```
<sampling name="$l10n_pa_sampledArea" sampledColor="0.1022 0.0168 0.0212"
sampledColorBlind="0.0061 0.0061 0.0130" pricePerSample="5 10 15"
analyseTimeSecPerSample="5">
<texts idleText="$l10n_ui_precisionFarming_laboratory_idle"
analyseText="$l10n_ui_precisionFarming_laboratory_analyse"/>
</sampling
```

I also use the mod FS19_PrecisionFarmingAddon by Royal Modding. Here I also change the prices for their services. This I do in the file \modules\geologistModule.lua.

Table 5. Change of prices in mod PrecisionFarmingAddon. In modules\geologistModule.lua.

```
    self.samplePerHectare = 10
    self.basePrice = {10, 20, 40}
    self.pricePerHectare = {25, 50, 75}
```

When there are three numbers, they apply to the game leves easy, normal, hard.

2 Parameter definition

To facilitate easier location of the model parameters, far the majority of parameters are defined in the script **RealNumbersInitialization**. The parameters defined here are then passed on to the following scripts for processing. You can change the value of existing parameters, but you should not change the name of the variable. If there is a comma separator or a brace "}" behind a number, it must not be removed. All parameters defined here are stored in a global table "RN". Elements in the global table then follow the naming convention RN.cropDensity, RN.soilType, RN.annualLoanInterest, and so on.

Table 6. Crop input parameters. Similar for all crop types.

```
RN.fruits.BARLEY                  = "BARLEY";
RN.cropDensity.BARLEY             = 0.618; -- kg/L
RN.cropYield.BARLEY               = 64.94; -- GEO DE, 100 kg/ha
RN.yieldRange.BARLEY              = 0.237; -- GEO DE,
RN.seedDensity.BARLEY             = 0.618; -- kg/L
RN.TSM.BARLEY                     = 40;    -- 1000 seed mass
RN.plantsPerSqm.BARLEY            = 360;   -- number of plants per sqm   DK: 360 - Alberta: 210
RN.germination.BARLEY             = 90;    -- Percentage of seeds that germinate
RN.seedUsagePerSqm.BARLEY         = 0;     -- kg/sqm,
RN.seedPricePer100kg.BARLEY       = 37.00; -- GEO DE, price / 100 kg
RN.cropPricePer100kg.BARLEY       = 15.81; -- GEO DE, price / 100 kg
RN.seederCalibration.BARLEY       = 1.000; -- If seeder calibration is wanted.
RN.Nitrogen.BARLEY                = 140;   -- kg/ha Nitrogen  (N) fertilizer per year
RN.Phosphate.BARLEY               = 25 ;   -- kg/ha Phosphate (P) fertilizer per year
RN.Potassium.BARLEY               = 40;    -- kg/ha Potassium (K) fertilizer per year
RN.cropProtectionCost.BARLEY      = 70;    -- DK: 70; Ontario: 70;
RN.growthDays.BARLEY              = 110;   -- Real-life days from seeding to harvest or between cuts
RN.manureApplications.BARLEY      = 1;     -- Number of solid manure applications
RN.slurryApplications.BARLEY      = 0;     -- Number of liquid manure applications
RN.limeApplications.BARLEY        = 1/3;   -- Number of lime applications
RN.isPlowing.BARLEY               = 1;     -- If plowing set to 1 (one), if not plowing set to 0 (zero)
RN.isDirectSeeding.BARLEY         = 0;     -- 0: tilling, seeding and rolling. 1: Direct seeding.
RN.solidFertApplications.BARLEY   = 1;     -- Number of solid fertilizer applications
RN.liquidFertApplications.BARLEY  = 1;     -- Number of liquid fertilizer applications
RN.herbicideApplications.BARLEY   = 1;     -- Number of liquid fertilizer applications
RN.seederType.BARLEY              = "SEEDERS";
RN.harvesterType.BARLEY           = "HARVESTERS";
```

We all make mistakes. It is therefore strongly advised that you keep backups of RealNumbersInitialization.lua. To remember the original value, I often copy/paste the original number into the comment field (a comment starts with "- -") before overwriting it with a new value.

The standard fruits: Barley, canola, cotton, drygrass, grass, maize, oat, oilseed radish, poplar, potato, soybean, sugar beet, sugarcane, sunflower, weed, wheat.

The extra fruits: Alfalfa, asparagus, beans, black beans, cabbage, carrot, clover, coffee, cranberry, dry lucerne, fieldgrass, hemp, hops, horsegrass, incarase grass, lettuce, linseed, lucerne, millet, miscanthus, mustard, onion, pasturegrass, peanut, peas, poppy, red cabbage, rice, rye, sorghum, spelt, sudan grass, tobacco, triticale, white cabbage.

The mod reads all fruit types included in a given map. If the same fruit type is also defined in RealLifeNumbers, then parameters from RealLifeNumbers are used. Otherwise map data is used. For a map with fewer fruits, the unused fruits will be ignored. For a map with more fruits, map data will be used for the fruits missing in my mod. Map data for fruits may not be real-life data, hence a much higher yield or sell price could possibly be observed for those extra fruits, which have not been defined in RealLifeNumbers. An example of fruit definitions is listed in Table .

While the RN.growthDays parameter has been kept for reference, it is not used. Seasons now determines the number of days between seeding and harvesting.

A new parameter **cropProtectionCost** has been added. It contains an estimate of the total expense for chemicals (herbicides, fungicides, pesticides) applied to the crop. Its application is only to make a **Cost of Production** calculation for each crop.

The parameters concerning number and types of field jobs are new additions in version 1.2.3.8. They have no effect on the actual game play. They are used to predict crop production cost and in particular the expenses associated with field work.

3 Crop yield

The script **RealNumbersCropYield** sets the bulk material density and harvest yield of the crops. For crop producing straw, the windrow yield is also set. A short excerpt is shown in Table 7. The log file contains parameter values for all crops on the map.

Values for bulk crop density vary depending on the crop variety and moisture content. In this mod, values have been obtained from the agricultural service of the province of Alberta, Canada as well as from numerous documents posted on the internet.

Values for crop yield depends very much on climate, geographical location and intensity of field preparation and fertilization. For maps within EU, crop yield values have been obtained from the statistical service of the European Union (EUROSTAT). In EU, annual yields are averaged from 2009 to 2018. Similar data is available from the USDA for the 12 agricultural regions in the US.

Figure 2. Harvesting. What yield to expect?

The information about crops can be used to select between crops and to determine how many hectares are needed, if you need a known amount of feed or number of bales. The price information allows the user to compare income per hectare for different fruits, a much more valuable information than the crop yield if you plan to sell your harvest.

Table 7. Example of calculated grain crop output data printed to the log.

```
BARLEY
SEED_BARLEY
Windrow name : STRAW
BARLEY massPerLiter                          =       0.6180  kg/L
Yield randomness scaling                     =       1.0000
BARLEY base yield                            =       0.4833  L/sqm
BARLEY base yield                            =     4833      L/Ha
BARLEY no-plough loss                        =     725       L/Ha
BARLEY no-weeding loss                       =     967       L/Ha
BARLEY liming gain                           =     725       L/Ha
BARLEY 1x fertilizing gain                   =     805       L/Ha
BARLEY max yield                             =     9667      L/Ha
BARLEY windrowLiterPerHa                     =    34925      L/Ha
BARLEY round bales Per Ha                    =      23.4395  Bales/Ha
BARLEY square bales Per Ha                   =      13.4845  Bales/Ha
BARLEY seed Mass Per Liter                   =       0.6180  kg/L
BARLEY seed Mass Per Ha                      =     160.0000  kg/Ha
BARLEY seed Volume Per Ha                    =     258.8997  L/Ha
BARLEY seed Cost Per Liter                   =       0.2966 €/L
BARLEY seed Cost Per Ha                      =      76.8000 €/Ha
BARLEY Lime Cost Per Ha (1/3)                =      27.7667 €/Ha
BARLEY NPK Cost Per Ha                       =     171.0521 €/Ha
BARLEY Crop protection CostPerHa             =      70.0000 €/Ha
BARLEY Supply costs Per Ha                   =     345.6187 €/Ha
BARLEY price Per 1000 Liter                  =      99      €/1000 L
BARLEY Gross income per ha - no loss         =      958     €/Ha
BARLEY Net income per ha - no loss           =      612     €/Ha
BARLEY Straw-bale income per ha              =      351     €/Ha
```

Table 8. Example of calculated vegetable crop output data printed to the log.

```
CARROT
SEED_CARROT
CARROT massPerLiter                          =       0.6410  kg/L
Yield randomness scaling                     =       1.0000
CARROT base yield                            =       3.7711  L/sqm
CARROT base yield                            =    37711      L/Ha
CARROT no-plough loss                        =     5657      L/Ha
CARROT no-weeding loss                       =     7542      L/Ha
CARROT liming gain                           =     5657      L/Ha
CARROT 1x fertilizing gain                   =     6285      L/Ha
CARROT max yield                             =    75423      L/Ha
CARROT seed Mass Per Liter                   =       0.4000  kg/L
CARROT seed Mass Per Ha                      =       2.7625  kg/Ha
CARROT seed Volume Per Ha                    =       6.9063  L/Ha
CARROT seed Cost Per Liter                   =      27.2000 €/L
CARROT seed Cost Per Ha                      =     187.8500 €/Ha
CARROT Lime Cost Per Ha (1/3)                =      27.7667 €/Ha
CARROT NPK Cost Per Ha                       =     363.7708 €/Ha
CARROT Crop protection CostPerHa             =     230.0000 €/Ha
CARROT Supply costs Per Ha                   =     809.3875 €/Ha
CARROT price Per 1000 Liter                  =      320     €/1000 L
CARROT Gross income per ha - no loss         =    24125     €/Ha
CARROT Net income per ha - no loss           =    23315     €/Ha
```

Crop yield varies from year to year. For some crops it varies more than for others (Table 9). Standard deviation is a statistical measure of how much a set of numbers deviates from their mean value. If the frequency of outcomes in a random process is bell-shaped it is called a normal distribution.

About 96 percent of all outcomes with a normal distribution lies within +/-2 standard deviations. It has not been investigated whether variations in crop yield have a normal distribution. Nevertheless, this measure is used here to create reasonable variation in crop yield. The right most column in Table 9 shows the assumed maximum variation divided by the mean, hence presenting yield variation as a fraction of the mean yield. Root crops vary less than 10%, grain crops about 20%, and oilseeds, canola, sunflower and soybean between 36 and 42% in the EU.

Table 9. Mean and variations in crop yield. Germany, 2009 – 2018.

Crop	Mean yield (100 kg/ha)	Variation/mean 2 std/mean
Wheat	75.81	0.198
Barley	64.94	0.237
Oat	46.00	0.254
Maize	96.25	0.213
Potatoes	430.7	0.090
Sugarbeet	729.2	0.071
Oilseeds	36.54	0.363
Canola/rape	36.16	0.383
Sunflower	20.56	0.460
Soybeans	29.23	0.416

FS19_RealLifeNumbers has a feature for adding randomness to the crop yield. However, this approach is purely a matter of random scaling with no bearing on weather conditions, crop rotation and other real-life factors which influence yield. The **Seasons** mod adds crop yield variation based on weather conditions and crop rotation; hence I see no real use for that feature in FS19_RealLifeNumbers. If a user wants additional variation the feature can be turned on by setting the variable `randomness = 1`.

Seasons: Some limited testing shows no sign that the Seasons mod overrides the yield parameters defined by RealLifeNumbers. My tests show yield variations within +/- 20% confirming that the Seasons mod influences crop yield in a satisfactory manner.

The windrow yield by weight is defined as 80% of the grain yield by weight. The windrow yield by volume is calculated using the mass density of a straw bale here set to 0.13 kg/L ($8\frac{\text{lb}}{\text{ft}^3}$). A windrow loss of 5% is incorporated. These scaling parameters are set so that the straw bale yield is around 27 round bales and 20 square bales per hectare.

The growing days for crops, i.e. the number of days from seeding to harvest varies from one crop to another and from one geographical location to another. The USDA has published data on planting and harvest dates for a range of crops grown in the US. Figure 3 shows an example for spring barley. By counting the days between the middle seeding date and the middle harvest date, the number of growth days has been determined for a range of crops.

Seasons: Now Seasons controls the duration of the growth season. The growthdays parameter in RealLifeNumbers has no effect but has been kept for reference purpose.

For some crops, statistical information is missing at EUROSTAT/USDA for a given country or agricultural region. In such cases, either the EU average is used, or the US average is used. The most likely reason why such values are missing is that the crop is not grown in this part of the world.

Although possible, mod users playing for realism should question the idea of growing cotton, coffee, sugarcane or tobacco in Northern Europe.

Barley, Spring: Usual Planting and Harvesting Dates, by State

State	1996 Harvested Acres (000)	Usual Planting Dates			Usual Harvesting Dates		
		Begin	Most Active	End	Begin	Most Active	End
AK	6.9	May 5	May 10 - May 25	Jun 5	Aug 20	Sep 1 - Sep 25	Oct 5
CA 1/	200	Feb 20	Mar 1 - May 1	May 15	Aug 15	Sep 1 - Sep 20	Oct 1
CO	92	Mar 15	Apr 5 - May 5	May 15	Jul 10	Jul 25 - Sep 5	Sep 20
ID	730	Mar 24	Apr 7 - May 5	May 26	Jul 28	Aug 11 - Sep 8	Sep 29
KS 2/		Mar 1	Mar 5 - Apr 1	May 1	Jun 10	Jun 25 - Jul 1	Jul 10
MI	25	Apr 15	Apr 25 - May 8	May 21	Jul 26	Aug 3 - Aug 19	Aug 31
MN	520	Apr 16	Apr 26 - May 27	Jun 5	Jul 26	Aug 8 - Sep 7	Sep 24
MT	1,200	Apr 7	Apr 21 - May 14	Jun 1	Aug 4	Aug 15 - Sep 6	Sep 28
NE	17	Mar 20	Mar 25 - Apr 10	Apr 18	Jul 18	Jul 20 - Jul 25	Jul 30
NV 1/	5	Apr 5	Apr 15 - May 15	May 20	Jul 20	Jul 25 - Aug 25	Sep 5
ND	2,600	Apr 21	May 2 - May 15	May 26	Jul 30	Aug 8 - Aug 23	Sep 6
OR	150	Sep 1	Mar 30 - May 15	May 15	Jul 5	Aug 5 - Aug 25	Sep 1
SD	145	Apr 6	Apr 17 - May 5	May 20	Jul 12	Jul 23 - Aug 8	Aug 20
UT	100	Mar 20	Apr 1 - Apr 20	May 10	Jul 15	Jul 25 - Aug 15	Sep 1
WA	440	Mar 1	Apr 1 - Apr 30	May 20	Jul 15	Aug 1 - Aug 30	Sep 15
WI	75	Apr 5	Apr 10 - May 10	May 15	Jul 15	Jul 25 - Aug 20	Sep 1
WY	120	Mar 15	Mar 28 - Apr 28	May 28	Jul 29	Aug 8 - Aug 31	Sep 21

Figure 3. US seed and harvest days for spring barley.[1]

A few new calculated values have been added in the crop output tables (shown in bold text in Table 7 and Table 8). They highlight supply cost for fertilizer and chemicals used for crop protection. The gross income from selling the harvested crop as well as the net income (gross income - supply cost) are shown. Net income is not profit. Net income must pay the variable and fixed costs of equipment. A new script predicting equipment economy is presented in a later chapter.

[1] https://swat.tamu.edu/media/90113/crops-typicalplanting-harvestingdates-by-states.pdf

Table 10. Example summary of crop yield. Press lAlt-ry. Rustic Acres 4 by cazz64. US map.

ALFALFA max yield	=	39072	L/Ha
BARLEY max yield	=	5977	L/Ha
CABBAGE max yield	=	99238	L/Ha
CANOLA max yield	=	2640	L/Ha
CARROT max yield	=	75423	L/Ha
CLOVER max yield	=	51282	L/Ha
COFFEE max yield	=	2228	L/Ha
COTTON max yield	=	5522	L/Ha
DECOFOLIAGE max yield	=	24000	L/Ha
DRYALFALFA max yield	=	32849	L/Ha
DRYCLOVER max yield	=	47348	L/Ha
DRYGRASS max yield	=	51553	L/Ha
GRASS max yield	=	55177	L/Ha
HEMP max yield	=	3475	L/Ha
HOPS max yield	=	2288	L/Ha
LETTUCE max yield	=	108299	L/Ha
MAIZE max yield	=	15617	L/Ha
MILLET max yield	=	2924	L/Ha
MUSTARD max yield	=	1151	L/Ha
OAT max yield	=	5811	L/Ha
OILSEEDRADISH max yield	=	3563	L/Ha
ONION max yield	=	79064	L/Ha
POPLAR max yield	=	28200	L/Ha
POPPY max yield	=	11600	L/Ha
POTATO max yield	=	51107	L/Ha
REDCABBAGE max yield	=	99238	L/Ha
RICE max yield	=	15262	L/Ha
RYE max yield	=	2734	L/Ha
SOYBEAN max yield	=	4510	L/Ha
SUGARBEET max yield	=	50886	L/Ha
SUGARCANE max yield	=	115743	L/Ha
SUNFLOWER max yield	=	3883	L/Ha
TOBACCO max yield	=	3170	L/Ha
WEED max yield	=	0	L/Ha
WHEAT max yield	=	5952	L/Ha
Alfalfa silage max yield	=	37118	L/Ha
Clover silage max yield	=	48718	L/Ha
Grass silage max yield	=	52418	L/Ha

Vegetable crops tend to give yields comparable to root crops but have a higher sell price and a shorter growth season. Many vegetable crops can have two harvests per year, making vegetable crops very profitable compared to grain crops, even when real-life numbers are used.

There is no doubt, that playing with the mod FS19_RealLifeNumbers, the player is experiencing a much bleaker economy than in the standard game. However, using multifruit maps with plenty of vegetable fruits and renting fields and expensive harvesters instead of buying, can improve the economy.

In my perspective, leasing a harvester and putting a helper on it, is like hiring a contractor. Some players argue, leasing for a few days is unrealistic, and I agree. If a farmer leases a tractor, it would be for several years. On the other hand, when it comes to harvesters, there is no point in long term leasing, unless you roleplay as a contractor. Short term leasing of harvesters is quite legitimate if you perceive it as hiring a contractor for a few days to harvest your crop.

Figure 4. Harvesting cabbage.

Table 11. Example summary of crop income per hectare. Press lAlt-ry. Welcome to Felsbrunn 5 by MC.

BARLEY max yield	=	10508	L/Ha
CABBAGE max yield	=	99238	L/Ha
CANOLA max yield	=	5613	L/Ha
CARROT max yield	=	75423	L/Ha
COTTON max yield	=	430	L/Ha
DRYGRASS max yield	=	51553	L/Ha
GRASS max yield	=	55177	L/Ha
HOPS max yield	=	2235	L/Ha
LETTUCE max yield	=	108299	L/Ha
MAIZE max yield	=	13442	L/Ha
MILLET max yield	=	2924	L/Ha
OAT max yield	=	11165	L/Ha
OILSEEDRADISH max yield	=	4568	L/Ha
ONION max yield	=	79064	L/Ha
POPLAR max yield	=	28200	L/Ha
POPPY max yield	=	11600	L/Ha
POTATO max yield	=	57488	L/Ha
REDCABBAGE max yield	=	99238	L/Ha
RYE max yield	=	4659	L/Ha
SORGHUM max yield	=	5342	L/Ha
SOYBEAN max yield	=	3722	L/Ha
SPELT max yield	=	9835	L/Ha
SUGARBEET max yield	=	102643	L/Ha
SUGARCANE max yield	=	1571	L/Ha
SUNFLOWER max yield	=	5049	L/Ha
TOBACCO max yield	=	2549	L/Ha
TRITICALE max yield	=	7832	L/Ha
WEED max yield	=	0	L/Ha
WHEAT max yield	=	9835	L/Ha
Alfalfa silage max yield	=	37118	L/Ha
Clover silage max yield	=	48718	L/Ha
Grass silage max yield	=	52418	L/Ha

Figure 5. Harvesting carrots.

4 Grass, hay, and silage yield

In Farming Simulator, a round bale has a diameter of 1.3 m and a height of 1.12 m, giving it a volume of 1487 Liters. Square bales are 1.2 m x 0.9 m x 2.4 m giving it a volume of 2592 Liters. Regardless of the actual dimensions of the bales, Farming Simulator sets the standard bale volume at a very large 4000 L. Using the mod **VariableBaleCapacity** by sperrgebiet, I set the baler to produce round bales of 1500 L and square bales of 2600 L. This requires editing the possible bale volumes in the mod and the modsettings files using a text editor (see section 1.10).

Table 12. Yield of grass per cut. Round bales = 1500 L, square bales = 2600 L.

```
GRASS
SEED_GRASS
Windrow name : WETGRASS_WINDROW
GRASS massPerLiter                          =      0.3900  kg/L
Yield randomness scaling                    =      1.0000
GRASS base yield                            =      2.7588  L/sqm
GRASS base yield                            =   27588      L/Ha
GRASS no-plough loss                        =    4138      L/Ha
GRASS no-weeding loss                       =    5518      L/Ha
GRASS liming gain                           =    4138      L/Ha
GRASS 1x fertilizing gain                   =    4598      L/Ha
GRASS max yield                             =   55177      L/Ha
GRASS windrowLiterPerHa                     =   52418      L/Ha
GRASS round bales Per Ha                    =     35.1799  Bales/Ha
GRASS square bales Per Ha                   =     20.2386  Bales/Ha
GRASS seed Mass Per Liter                   =      0.3100  kg/L
GRASS seed Mass Per Ha                      =      8.5556  kg/Ha
GRASS seed Volume Per Ha                    =     27.5986  L/Ha
GRASS seed Cost Per Liter                   =      1.0850 €/L
GRASS seed Cost Per Ha                      =     29.9444 €/Ha
GRASS Lime Cost Per Ha (1/3)                =     27.7667 €/Ha
GRASS NPK Cost Per Ha                       =    194.4479 €/Ha
GRASS Crop protection CostPerHa             =    154.0000 €/Ha
GRASS Supply costs Per Ha                   =    259.0035 €/Ha
GRASS price Per 1000 Liter                  =     25      €/1000 L
GRASS Gross income per ha - no loss         =    1370     €/Ha
GRASS Net income per ha - no loss           =    1111     €/Ha
Supply costs averaged over 5 years for grass, clover and alfalfa
```

The density of grass and silage bales is set to $0.39\frac{kg}{L}$ and that of hay bales to $0.18\frac{kg}{L}$. A 1500-liter round silage bale then weighs $585\ kg$ and a hay round bale $270\ kg$. Square bales weigh $1014\ kg$ and $468\ kg$. The yield is set to produce about 26 round bales and about 15 square bales per hectare.

The volume of bales in the store are 4000 L for both round and square.

Table 13. Yield of hay per cut. 2 cuts per year. Round bales = 1500 L, square bales = 2600 L.

```
DRYGRASS
SEED_DRYGRASS
Windrow name : DRYGRASS_WINDROW
DRYGRASS massPerLiter                      =       0.1800  kg/L
Yield randomness scaling                   =       1.0000
DRYGRASS base yield                        =       2.5776  L/sqm
DRYGRASS base yield                        =    25776      L/Ha
DRYGRASS no-plough loss                    =     3866      L/Ha
DRYGRASS no-weeding loss                   =     5155      L/Ha
DRYGRASS liming gain                       =     3866      L/Ha
DRYGRASS 1x fertilizing gain               =     4296      L/Ha
DRYGRASS max yield                         =    51553      L/Ha
DRYGRASS windrowLiterPerHa                 =    46397      L/Ha
DRYGRASS round bales Per Ha                =      31.1392  Bales/Ha
DRYGRASS square bales Per Ha               =      17.9140  Bales/Ha
DRYGRASS seed Mass Per Liter               =       0.3100  kg/L
DRYGRASS seed Mass Per Ha                  =       8.5556  kg/Ha
DRYGRASS seed Volume Per Ha                =      27.5986  L/Ha
DRYGRASS seed Cost Per Liter               =       1.0850 €/L
DRYGRASS seed Cost Per Ha                  =      29.9444 €/Ha
DRYGRASS NPK Cost Per Ha                   =     228.6100 €/Ha
DRYGRASS Crop protection CostPerHa         =     154.0000 €/Ha
DRYGRASS Supply costs Per Ha               =     412.5544 €/Ha
DRYGRASS price Per 1000 Liter              =       21     €/1000 L
DRYGRASS Gross income per ha - no loss     =     1073     €/Ha
DRYGRASS Net income per ha - no loss       =      660     €/Ha
```

Table 14. Yield of alfalfa hay per cut. 3 cuts per year. Round bales = 1500 L, square bales = 2600 L.

```
DRYALFALFA
SEED_DRYALFALFA
Windrow name : DRYALFALFA_WINDROW
DRYALFALFA massPerLiter                    =       0.1800  kg/L
Yield randomness scaling                   =       1.0000
DRYALFALFA base yield                      =       1.6424  L/sqm
DRYALFALFA base yield                      =    16424      L/Ha
DRYALFALFA no-plough loss                  =     2464      L/Ha
DRYALFALFA no-weeding loss                 =     3285      L/Ha
DRYALFALFA liming gain                     =     2464      L/Ha
DRYALFALFA 1x fertilizing gain             =     2737      L/Ha
DRYALFALFA max yield                       =    32849      L/Ha
DRYALFALFA windrowLiterPerHa               =    29564      L/Ha
DRYALFALFA round bales Per Ha              =      19.8416  Bales/Ha
DRYALFALFA square bales Per Ha             =      11.4146  Bales/Ha
DRYALFALFA seed Mass Per Liter             =       0.7370  kg/L
DRYALFALFA seed Mass Per Ha                =      25.0000  kg/Ha
DRYALFALFA seed Volume Per Ha              =      33.9213  L/Ha
DRYALFALFA seed Cost Per Liter             =       4.8274 €/L
DRYALFALFA seed Cost Per Ha                =     163.7500 €/Ha
DRYALFALFA NPK Cost Per Ha                 =     285.1000 €/Ha
DRYALFALFA Crop protection CostPerHa       =      74.0000 €/Ha
DRYALFALFA Supply costs Per Ha             =     522.8500 €/Ha
DRYALFALFA price Per 1000 Liter            =       21     €/1000 L
DRYALFALFA Gross income per ha - no loss   =      683     €/Ha
DRYALFALFA Net income per ha - no loss     =      161     €/Ha
```

The yield of grass, clover and alfalfa/Lucerne is calculated based on an assumed value of annual drymatter production per hectare.

Table 15. Growth parameters for grass, clover and alfalfa. (In RealNumbersInitialization).

```
RN.annualGrassCuttings                          =   2;
RN.annualAlfalfaCuttings                        =   3;

RN.growth.grassDryMatterMassPerHa               = 17000/RN.annualGrassCuttings;
RN.growth.alfalfaDryMatterMassPerHa             = 16000/RN.annualAlfalfaCuttings;
RN.growth.cloverDryMatterMassPerHa              = 15000/RN.annualGrassCuttings;
```

Alfalfa is usually cut more times per year than grass and clover. Here we assume that grass and clover is cut two times and alfalfa three times per year. The number 17000 is the annual amount of dry matter in kg/ha for grass, and similar for clover and alfalfa. To get the mass per hectare of dry mater per cutting, the annual amount is simply divided by the number of cuttings per year. If we divide this number by the dry matter fraction, we get the fresh matter mass per hectare per cutting. Here we need to distinguish between cutting for silage or for hay.

Table 16. Growth parameters for grass, clover and alfalfa. (In RealNumbersInitialization).

```
RN.growth.alfalfaDryMatterFraction              = 0.350;
RN.growth.cloverDryMatterFraction               = 0.375;
RN.growth.grassDryMatterFraction                = 0.395;

RN.growth.dryalfalfaDryMatterFraction           = 0.902;
RN.growth.drycloverDryMatterFraction            = 0.880;
RN.growth.drygrassDryMatterFraction             = 0.916;
RN.growth.alfalfaSilageDryMatterFraction        = 0.350;
RN.growth.cloverSilageDryMatterFraction         = 0.375;
RN.growth.grassSilageDryMatterFraction          = 0.395;

RN.growth.windrowLoss                           = 0.05;
RN.growth.tedderLoss                            = 0.05;
RN.strawYieldFactor                             = 0.80;
```

To convert from mass of dry matter to mass of fresh matter (as fed), we divide the mass of dry matter by the dry matter fraction:

$$Fresh\ matter\ (as\ fed) = \frac{Mass\ of\ dry\ matter}{Dry\ matter\ fraction}$$

Uncut pasture grass may have a water content of as much as 85%. Hence its dry matter fraction is 15%. When cutting grass for silage, the water content must drop slightly in order for fermentation to occur. Typical water content when baling for silage is 60 - 65% meaning that the dry matter content is 35 - 40%.

For hay, much more water needs to evaporate before baling. Often the hay is tedded or left in the sun until the water content is 10-15% So the dry matter fraction of hay is 85 - 90%.

In Table 13, grass hay yield is at 51553 L/ha. However, tedding and windrowing each is set to have a loss of 5%, hence the actual windrow yield has dropped to 46397 L/ha. Assuming round bales of 1500 L and square bales of 2590 Liters, we will get 31 round bales per ha and almost 18 square bales per ha. For alfalfa we will get almost 20 round bales per ha and 11 square bales per ha, but this is for one out of three cuts per year (Table 14).

The straw yield factor is the mass of straw divided by the mass of grain. The default value is set to a rule of thumb value of 80%.

A new script is introduced in version 1.2.3.6, **RealNumbersForageProductionCost.lua**, which predicts the cost of bale production and compares with bale prices. For the example shown in Table 17, production cost exceeds sell price. The cost of production includes the fixed and variable cost of machinery used for making bales (mower, rake, tedder, baler, wrapper, twine, plastic wrap, fuel, etc.). More on equipment cost in a later chapter.

Table 17. Bale cost production.

Alfalfa Mass Per Ha	=	15238	kg/ha
Alfalfa Bale Density	=	0.3900	kg/L
Alfalfa Volume Per Ha	=	39072	L/ha
Alfalfa Net Volume Per Ha	=	37118	L/ha
Alfalfa Round Bale Volume	=	1490	L
Alfalfa Square Bale Volume	=	2590	L
Alfalfa Round Bale Mass	=	581	kg
Alfalfa Square Bale Mass	=	1010	kg
Alfalfa Round Bales Per Ha	=	24.9117	-
Alfalfa Square Bales Per Ha	=	14.3314	-
Alfalfa Income Per Ha	=	922	€
Alfalfa Round Bale Cost	**=**	**81.1234**	**€**
Alfalfa Round Bale Price	**=**	**37.0000**	**€**
Alfalfa Square Bale Cost	**=**	**129.1708**	**€**
Alfalfa Square Bale Price	**=**	**65.0000**	**€**
Alfalfa Price Per 1000 L	=	24.8322	€/1000L
Alfalfa Price Per 100 kg	=	6.3672	€/100kg
straw Round Bale Cost	**=**	**16.5604**	**€**
straw Round Bale Price	**=**	**15.0000**	**€**
straw Square Bale Cost	**=**	**33.6702**	**€**
straw Square Bale Price	**=**	**26.0000**	**€**
straw Price Per 1000L	=	10.0671	€/1000L
straw Price Per 100kg =	=	7.7439	€/100kg

5 Seed usage

The script **RealNumbersCropYield** also defines how much seed needs to be applied per area for seeded and planted crops. This depends both on the crop type and the season for seeding and planting.

Seed resellers often provide an equation for calculating the seed rate:

$$seedUsagePerHa = \frac{TSM(gram) \times plantsPerSqm\ (m^{-2})}{Germination\ percentage}$$

TSM means “thousand seed mass” and is entered in grams. As an example, lets us look at spring barley. $TSM = 30\ g, plantsPerSqm = 300, Germinatin\ percentage = 90\%$. Entering these numbers in the equation we get:

$$seedUsagePerHa = \frac{30\ g \times 300\ (m^{-2})}{90} = 100\frac{kg}{ha}$$

The volume of seed per hectare is obtained by dividing the mass by the density of the seed. Example data is shown in Table 7 and Table 8.

Seed usage depends on the germination percentage, a factor that varies considerably.

Table 18. Germination percentage.

	Seed bed preparation		
	Good	Average	Poor
Spring	95%	90%	80%
September	90%	85%	80%
October	85%	80%	75%

Seasons: Some tests have indicated that Seasons does not interfere with the seed usage defined in RealLifeNumbers.

RealisticSeeder: This mod by ifko[nator] assigns specific seeds to specific crops. The seed pallets used in realisticSeeder has been defined as pallets in RealLifeNumbers, so that real-life price levels can be set to each pallet. Table 19 shows the seed pallets with their volume and price per pallet. The default pallet volume in realisticSeeder is 2100 L. However, 2100 L of seed can for some fruits like sugarbeet cover more than 100 Ha and cost more than 100,000 €. For this reason, RealLifeNumbers changes a few parameters setup by realisticSeeder. RealLifeNumbers already knows how much seed to apply per hectare for each crop type. RealLifeNumbers then calculate how much seed is required to seed 3 hectares, converts this amount to volume and set the pallet volume to this number. Hence the pallet volumes in Table 19 contains enough seed to seed 3 hectares. The mod user can change the hectares covered to another value. The price for the pallet scales with volume of seed.

Table 19. Seed pallet volume and cost.

PALLETS	wheat seed	Id : 850,	380 L,	157.23 €
PALLETS	barley seed	Id : 851,	460 L,	154.59 €
PALLETS	oat seed	Id : 852,	710 L,	102.78 €
PALLETS	canola seed	Id : 853,	20 L,	371.25 €
PALLETS	soybean seed	Id : 854,	320 L,	512.86 €
PALLETS	oilseed radish seed	Id : 855,	130 L,	128.85 €
PALLETS	grass seed	Id : 856,	90 L,	92.95 €
PALLETS	maize seed	Id : 857,	120 L,	620.25 €
PALLETS	seed potatoes	Id : 858,	1000 L,	237.53 €
PALLETS	seed carrots	Id : 859,	30 L,	829.09 €
PALLETS	seed onions	Id : 860,	50 L,	2435.30 €
PALLETS	sugar beet seed	Id : 861,	20 L,	1021.20 €
PALLETS	sunflower seed	Id : 862,	40 L,	35.63 €
PALLETS	cotton seed	Id : 863,	190 L,	750.85 €
PALLETS	rye seed	Id : 864,	400 L,	348.76 €
PALLETS	clover seed	Id : 865,	50 L,	270.66 €
PALLETS	spelt seed	Id : 866,	2100 L,	584.60 €
PALLETS	millet seed	Id : 867,	20 L,	96.15 €
PALLETS	alfalfa seed	Id : 868,	110 L,	537.94 €
PALLETS	triticale seed	Id : 869,	2100 L,	590.42 €
PALLETS	field grass seed	Id : 870,	2100 L,	1890.00 €
PALLETS	horse grass seed	Id : 871,	2100 L,	1890.00 €
PALLETS	pasture grass seed	Id : 872,	2100 L,	1890.00 €
PALLETS	miscanthus seed	Id : 873,	2100 L,	1890.00 €

The seed pallets with a volume of 2100 L are seeds for crops not included in the map. So, in this case, spelt, triticale and the four types of grasses are not on the map used here.

Figure 6. Planting potatoes stored in root crop bunker (modified silage bunker). Oberlausitz map by RitchiF.

Table 20. Seed rates, pallet volume and coverage.

Seed type		Seed rate (L/ha)	Pallet volume (L)	Pallets/ha	Ha/pallet
ALFALFA	:	33.92	110	0.308	3.2
BARLEY	:	151.02	460	0.328	3.0
CANOLA	:	4.31	20	0.216	4.6
CARROT	:	6.91	30	0.230	4.3
CLOVER	:	13.57	50	0.271	3.7
COTTON	:	60.67	190	0.319	3.1
GRASS	:	27.60	90	0.307	3.3
MAIZE	:	38.06	120	0.317	3.2
MILLET	:	6.03	20	0.302	3.3
OAT	:	235.98	710	0.332	3.0
OILSEEDRADISH	:	42.86	130	0.330	3.0
ONION	:	14.31	50	0.286	3.5
POTATO	:	2400.00	1000	2.400	0.4
RYE	:	132.15	400	0.330	3.0
SOYBEAN	:	103.63	320	0.324	3.1
SUGARBEET	:	3.74	20	0.187	5.4
SUNFLOWER	:	11.64	40	0.291	3.4
WHEAT	:	125.94	380	0.331	3.0

Pressing lAlt-ro will print an overview to the log file/screen with information about how many pallets you will need per hectare for a given crop. Although the default is 3 hectares per pallet, rounding of decimals will cause deviations from this number. The smaller the seed rate, the larger the deviation. Seed potatoes have a much larger volume than grain seeds, hence a pallet of seed potato will only cover about 0.4 ha (1 acre).

6 Spraying

The script **RealNumbersSpraying** defines the spray rate of sprayers and spreaders for the following types of spray material: solid fertilizer, liquid fertilizer, slurry, manure, digestate, compost, lime, and herbicde. The purpose of applying fertilizers to a field is to add enough amounts of nutrients so that the field will hold enough nutrients to feed the next crop. Real-life farmers thus start by making soil tests to determine, how much nutrient is already present in the field.

Figure 7. Spreading manure on top of lime.

The applied amount should ideally only be the difference between how much nutrient, a crop need, and how much is already present. How much fertilizer to apply depends on the nutrient concentration of the fertilizer type used as well as the nutrient need of the crop.

6.1 Nutrient need in crops.

Until the spring of 2021 there has not been a feature or a mod to manage the nutrient content in individual fields. With the release of the **Precision Farming** mod this has changed. Although this mod only considers the need for nitrogen, it is a very good first attempt. The script **RealNumbersPrecisionSpraying** is an update of the old script RealNumbersSpraying, where an approach similar to Precision Farming is taken. RLN does not set the spray rate as this is done by Precision Farming. **RealNumbersPrecisionSpraying** calculates the amount of NPK needed by each crop type as well as the amount of NPK source needed to apply the desired amount of N, P, and K.

The amount of nutrients removed by a certain crop can be looked up in tables. Typical values are listed in Table 21.

Table 21. Nutrient content removed from the field at harvest.

ALFALFA	N = 0.0 kg/ha	P2O5 = 80.0 kg/ha	K2O = 250.0 kg/ha
BARLEY	N = 140.0 kg/ha	P2O5 = 25.0 kg/ha	K2O = 40.0 kg/ha
CABBAGE	N = 90.0 kg/ha	P2O5 = 90.0 kg/ha	K2O = 90.0 kg/ha
CANOLA	N = 224.0 kg/ha	P2O5 = 24.0 kg/ha	K2O = 120.0 kg/ha
CARROT	N = 240.0 kg/ha	P2O5 = 82.0 kg/ha	K2O = 143.0 kg/ha
CLOVER	N = 289.0 kg/ha	P2O5 = 40.0 kg/ha	K2O = 250.0 kg/ha
COFFEE	N = 250.0 kg/ha	P2O5 = 40.0 kg/ha	K2O = 325.0 kg/ha
COTTON	N = 150.0 kg/ha	P2O5 = 112.0 kg/ha	K2O = 75.0 kg/ha
DECOFOLIAGE	N = 180.0 kg/ha	P2O5 = 45.0 kg/ha	K2O = 80.0 kg/ha
FIELD_GRASS	N = 170.0 kg/ha	P2O5 = 23.0 kg/ha	K2O = 70.0 kg/ha
GRASS	N = 170.0 kg/ha	P2O5 = 23.0 kg/ha	K2O = 70.0 kg/ha
HORSEGRASS	N = 170.0 kg/ha	P2O5 = 23.0 kg/ha	K2O = 70.0 kg/ha
HEMP	N = 110.0 kg/ha	P2O5 = 80.0 kg/ha	K2O = 140.0 kg/ha
HOPS	N = 150.0 kg/ha	P2O5 = 20.0 kg/ha	K2O = 100.0 kg/ha
LETTUCE	N = 140.0 kg/ha	P2O5 = 45.0 kg/ha	K2O = 230.0 kg/ha
LINSEED	N = 84.0 kg/ha	P2O5 = 34.0 kg/ha	K2O = 50.0 kg/ha
MAIZE	N = 140.0 kg/ha	P2O5 = 61.0 kg/ha	K2O = 36.0 kg/ha
MILLET	N = 120.0 kg/ha	P2O5 = 40.0 kg/ha	K2O = 55.0 kg/ha
MISCANTHUS	N = 80.0 kg/ha	P2O5 = 13.0 kg/ha	K2O = 75.0 kg/ha
MUSTARD	N = 90.0 kg/ha	P2O5 = 22.0 kg/ha	K2O = 65.0 kg/ha
OAT	N = 114.0 kg/ha	P2O5 = 22.0 kg/ha	K2O = 60.0 kg/ha
OILSEEDRADISH	N = 0.0 kg/ha	P2O5 = 0.0 kg/ha	K2O = 0.0 kg/ha
ONION	N = 180.0 kg/ha	P2O5 = 100.0 kg/ha	K2O = 170.0 kg/ha
PASTUREGRASS	N = 170.0 kg/ha	P2O5 = 23.0 kg/ha	K2O = 70.0 kg/ha
POPLAR	N = 225.0 kg/ha	P2O5 = 75.0 kg/ha	K2O = 75.0 kg/ha
POPPY	N = 50.0 kg/ha	P2O5 = 75.0 kg/ha	K2O = 75.0 kg/ha
POTATO	N = 150.0 kg/ha	P2O5 = 30.0 kg/ha	K2O = 135.0 kg/ha
REDCABBAGE	N = 90.0 kg/ha	P2O5 = 90.0 kg/ha	K2O = 90.0 kg/ha
RICE	N = 450.0 kg/ha	P2O5 = 180.0 kg/ha	K2O = 100.0 kg/ha
RYE	N = 150.0 kg/ha	P2O5 = 22.0 kg/ha	K2O = 70.0 kg/ha
SOYBEAN	N = 0.0 kg/ha	P2O5 = 45.0 kg/ha	K2O = 0.0 kg/ha
SPELT	N = 209.0 kg/ha	P2O5 = 24.0 kg/ha	K2O = 70.0 kg/ha
SUGARBEET	N = 209.0 kg/ha	P2O5 = 41.0 kg/ha	K2O = 299.0 kg/ha
SUGARCANE	N = 136.0 kg/ha	P2O5 = 50.0 kg/ha	K2O = 100.0 kg/ha
SUNFLOWER	N = 100.0 kg/ha	P2O5 = 50.0 kg/ha	K2O = 50.0 kg/ha
TOBACCO	N = 224.0 kg/ha	P2O5 = 145.0 kg/ha	K2O = 202.0 kg/ha
TRITICALE	N = 185.0 kg/ha	P2O5 = 22.0 kg/ha	K2O = 108.0 kg/ha
WEED	N = 0.0 kg/ha	P2O5 = 0.0 kg/ha	K2O = 0.0 kg/ha
WHEAT	N = 209.0 kg/ha	P2O5 = 24.0 kg/ha	K2O = 70.0 kg/ha
Mean values	N = 174.3 kg/ha	P2O5 = 57.2 kg/ha	K2O = 121.2 kg/ha

6.2 Nutrient content in fertilizer materials.

Seasons: The updated script assumes that each of the three fertilizer applications covers one third of the annual fertilizer amount.

Precision Farming: In this mod, only the need for nitrogen is considered. The annual nitrogen need for each crop is specified. It is assumed that the first application is organic and that this covers one third of the nitrogen need. The latter two thirds are given as an artificial fertilizer in one application. Thus, with Precision Farming only two applications are required.

We will first determine the nutrient content in the fertilizers. This varies between slurry, manure and digestate and is also dependent on the animal producing the organic waste (

Table 22). Only a fraction of the applied nutrients become available for crop absorption. The worst case is the nitrogen content in cow manure. It contains about 6 kg N per Tonne of manure, but only 10% is available for crop absorption. The majority evaporates to the atmosphere.

Table 22. Nutrient content in organic and artificial fertilizers. (crop av. = crop available)

```
FERTILIZER                  : N = 270.0 kg/Tonne, P2O5 =  60.0 kg/Tonne, K2O =  60.0 kg/Tonne
FERTILIZER crop av.         : N = 216.0 kg/Tonne, P2O5 =  48.0 kg/Tonne, K2O =  54.0 kg/Tonne
LIQUIDFERTILIZER            : N = 270.0 kg/Tonne, P2O5 =  60.0 kg/Tonne, K2O =  60.0 kg/Tonne
LIQUIDFERTILIZER crop av.   : N = 256.5 kg/Tonne, P2O5 =  57.0 kg/Tonne, K2O =  57.0 kg/Tonne
pigLIQUIDMANURE             : N =   3.6 kg/Tonne, P2O5 =   1.5 kg/Tonne, K2O =   2.2 kg/Tonne
pigLIQUIDMANURE crop av.    : N =   2.0 kg/Tonne, P2O5 =   0.8 kg/Tonne, K2O =   2.0 kg/Tonne
cowLIQUIDMANURE             : N =   2.6 kg/Tonne, P2O5 =   1.2 kg/Tonne, K2O =   2.5 kg/Tonne
cowLIQUIDMANURE crop av.    : N =   1.0 kg/Tonne, P2O5 =   0.7 kg/Tonne, K2O =   2.3 kg/Tonne
pigMANURE                   : N =   7.0 kg/Tonne, P2O5 =   6.0 kg/Tonne, K2O =   8.0 kg/Tonne
pigMANURE crop av.          : N =   1.1 kg/Tonne, P2O5 =   3.6 kg/Tonne, K2O =   7.2 kg/Tonne
cowMANURE                   : N =   6.0 kg/Tonne, P2O5 =   3.2 kg/Tonne, K2O =   9.4 kg/Tonne
cowMANURE crop av.          : N =   0.6 kg/Tonne, P2O5 =   1.9 kg/Tonne, K2O =   8.5 kg/Tonne
DIGESTATE                   : N =   4.9 kg/Tonne, P2O5 =   1.1 kg/Tonne, K2O =   3.5 kg/Tonne
DIGESTATE crop av.          : N =   2.7 kg/Tonne, P2O5 =   0.7 kg/Tonne, K2O =   3.1 kg/Tonne
COMPOST                     : N =   9.0 kg/Tonne, P2O5 =   5.5 kg/Tonne, K2O =   6.5 kg/Tonne
COMPOST crop av.            : N =   5.0 kg/Tonne, P2O5 =   3.3 kg/Tonne, K2O =   5.9 kg/Tonne
```

One clearly sees the labor advantage of artificial fertilizers, as they contain many times more nutrient per mass of fertilizer than organic sources. On the other hand, artificial fertilizer cannot supply the organic matter needed by the soil, hence manure and slurry should also be part of a fertilizer plan.

6.3 Amounts of fertilizer to be applied.

The strategy is to let the first fertilizer application cover the majority of N, P, and K needs and then let the second application provide whatever amounts are still needed to reach the target for both N, P, and K. If organic fertilizers are to be used, it should be in the first application. Then an artificial fertilizer (solid or liquid) of just the right ratios of N, P, and K are used to cover the gap. If an artificial fertilizer is also used for the first application, then N:P:K ratios of 27:6:6 are assumed.

It is now necessary for the mod user to specify the fertilizer sources (first and second) for each crop type. This is done in RealNumbersInitialization for arable crops and in RealNumbersForageCrops for grass type crops.

Table 23. Defining first and second fertilizer source. In RealNumbersInitialization.lua and in RealNumbersForageCrop.

```
RN.manureApplications.BARLEY          = 0;    -- Number of solid manure applications
RN.slurryApplications.BARLEY          = 1;    -- Number of liquid manure applications
RN.limeApplications.BARLEY            = 1/3;  -- Number of lime applications
RN.isPlowing.BARLEY                   = 1;    -- If plowing set to 1 (one
RN.isDirectSeeding.BARLEY             = 0;    -- If direct seeding set to 1 (one);
RN.solidFertApplications.BARLEY       = 0;    -- Number of solid fertilizer applications
RN.liquidFertApplications.BARLEY      = 1;    -- Number of liquid fertilizer applications
RN.fertFirstApplication.BARLEY        = "pigLIQUIDMANURE";
RN.fertSecondApplication.BARLEY       = "LIQUIDFERTILIZER";
RN.herbicideApplications.BARLEY       = 1;    -- Number of liquid fertilizer applications
RN.seederType.BARLEY                  = "SEEDERS";
RN.harvesterType.BARLEY               = "HARVESTERS";
RN.isBaling.BARLEY                    = 1;    -- If baling, set to 1 (one)
RN.baleType.BARLEY                    = "STRAW"; -- Bale type for crop, if any
```

The entries `fertFirstApplication` and `fertSecondApplication` are used to calculate the cost of fertilizer supplies. The entries `manureApplications/slurryApplications` and `solidFertApplications/liquidFertApplications` are used to calculate the equipment cost. Here, as an example, the first application is pig slurry, hence we must match this with slurry application. Likewise, the second application is liquid fertilizer. We must match this with liquid fertilizer application. The other entries are also used to calculate crop production costs.

A fixed price is set for organic fertilizers. For artificial fertilizers, the cost is calculated from a base price on N, P, and K. The prices for these are set in RealNumbersInitialization.lua. The price of fertilizer nutrients varies greatly from country to country. Hence the mod user may want to change these costs to local values.

Table 24. Cost of N, P, and K nutrients per kg.

```
RN.fertCostPerKg.N  = 0.22; -- €/kg DK: 0.87 €/kg; Ontario: 0.67 €/kg DE
RN.fertCostPerKg.P  = 0.36; -- €/kg DK: 1.47 €/kg; Ontario: 0.71 €/kg DE
RN.fertCostPerKg.K  = 0.55; -- €/kg DK: 0.67 €/kg; Ontario: 0.58 €/kg DE
```

Using these data, the following type of results are presented.

Table 25. Fertilizer costs for each crop type (per hectare).

			N	P	K	€/Ha
ALFALFA	annual need	kg/Ha	0.0	80.0	250.0	
cowMANURE	Available NPK	kg/Tonne	0.6	1.9	8.5	
cowMANURE	Spray rate	Tonne/Ha	0.0	41.7	29.6	
cowMANURE	Minimum Spray rate	Tonne/Ha	0.0	0.0	0.0	
cowMANURE	1st application	kg/Ha	0.0	0.0	0.0	0.0
LIQUIDFERTILIZER	2nd application	kg/Ha	0.0	80.0	250.0	208.1
ALFALFA	Total fertilizer supply cost per ha					208.1
			N	P	K	€/Ha
BARLEY	annual need	kg/Ha	140.0	25.0	40.0	
pigLIQUIDMANURE	Available NPK	kg/Tonne	2.0	0.8	2.0	
pigLIQUIDMANURE	Spray rate	Tonne/Ha	70.7	33.3	20.2	
pigLIQUIDMANURE	Minimum Spray rate	Tonne/Ha	20.2	20.2	20.2	
pigLIQUIDMANURE	1st application	kg/Ha	40.0	15.2	40.0	80.8
LIQUIDFERTILIZER	2nd application	kg/Ha	100.0	9.8	0.0	98.1
BARLEY	Total fertilizer supply cost per ha					178.9
			N	P	K	€/Ha
CANOLA	annual need	kg/Ha	224.0	24.0	120.0	
FERTILIZER	Available NPK	kg/Tonne	216.0	48.0	54.0	
FERTILIZER	Spray rate	Tonne/Ha	1.0	0.5	2.2	
FERTILIZER	Minimum Spray rate	Tonne/Ha	0.5	0.5	0.5	
FERTILIZER	1st application	kg/Ha	108.0	24.0	27.0	309.1
LIQUIDFERTILIZER	2nd application	kg/Ha	116.0	0.0	93.0	157.4
CANOLA	Total fertilizer supply cost per ha					466.6
			N	P	K	€/Ha
CARROT	annual need	kg/Ha	240.0	82.0	143.0	
cowMANURE	Available NPK	kg/Tonne	0.6	1.9	8.5	
cowMANURE	Spray rate	Tonne/Ha	400.0	42.7	16.9	
cowMANURE	Minimum Spray rate	Tonne/Ha	16.9	16.9	16.9	
cowMANURE	1st application	kg/Ha	10.1	32.5	143.0	67.6
FERTILIZER	2nd application	kg/Ha	229.9	49.5	0.0	247.5
CARROT	Total fertilizer supply cost per ha					315.1
			N	P	K	€/Ha
CLOVER	annual need	kg/Ha	289.0	40.0	250.0	
cowLIQUIDMANURE	Available NPK	kg/Tonne	1.0	0.7	2.3	
cowLIQUIDMANURE	Spray rate	Tonne/Ha	277.9	55.6	111.1	
cowLIQUIDMANURE	Minimum Spray rate	Tonne/Ha	55.6	55.6	55.6	
cowLIQUIDMANURE	1st application	kg/Ha	57.8	40.0	125.0	222.2
LIQUIDFERTILIZER	2nd application	kg/Ha	231.2	0.0	125.0	279.4
CLOVER	Total fertilizer supply cost per ha					501.6

Alfalfa does not require much nitrogen. The first application is therefore calculated to zero. Hence an artificial fertilizers is to be used instead.

For barley it is seen that 20.2 Tonne/Ha of pig slurry will cover the need for K completely. This provides 40 kg/Ha of N, 15.2 kg/Ha of P and 40 kg/Ha of K. The gap is then 100 kg/Ha of N and 9.8 kg/Ha of P. This is then supplied as a special mix in the second fertilizer application. The 20.2 Tonne/Ha of pig slurry is set at 4 €/Tonne, hence the cost is 80.8 €/Ha.

Even when your own animals produce the organic fertilizer, its value is added as a cost in Cost of Production calculations. This is so because you are losing a potential income by not selling it.

In the case of Canola, the first fertilizer is a solid fertilizer. At a rate of 05 Tonne/Ha it covers the entire need of phosphate (P). The second fertilizer is here chosen to be a liquid fertilizer. Its NPK ratio is set so that it covers the gap.

For carrot, the first application is set to be cow manure. It provides all the need for potassium (K) hence the second application only contains N and P.

For clover the first application (cow slurry) covers the total need for phosphate and the second application is a special mix of N and K.

Liquid sprayers

Take a look in the Nozzle catalogue from Hardy and you will see that spraying of herbicide and liquid fertilizer is almost a science in itself. Depending on the type of nozzle used many types of spray patterns can be achieved ranging from narrow streams to hollow and full cones. The amount of liquid fertilizer needed is assumed to be less than that for solid fertilizer, as the spray can be aimed more precisely, and nutrients come in closer contact with the plants. This is included in the script using the parameter (`RN.liqfertLiquidReductionFactor`).

Spray nozzles require a minimum volume flow rate to work properly. The ideal nozzle flow rate depends on the nozzle design and varies significantly among the enormous number of nozzle designs.

$$Broadcast\ spray\ rate\ \left(\frac{L}{ha}\right) = \frac{Nozzle\ flow\ rate\ \left(\frac{L}{min}\right) \times 600}{Speed\ (kph) \times Nozzle\ spacing\ (m)}$$

Most common nozzle spacings are 0.25m, 0.5 m, and 0.75 m.

For row crops, spraying fertilizer in narrow bands aligned with the crop rows reduces the waste of unused fertilizer. If the spray is banded rather than broadcasted, the treated area is less than the field area:

$$Treated\ area\ (ha) = \frac{Spray\ bandwidth\ (m)}{Nozzle\ spacing\ (m)} \times Field\ area\ (ha)$$

Band spraying thereby reduces the volume sprayed and the cost of fertilizer. To allow for this opportunity in the mod, we combine the two equations:

$$Banded\ spray\ rate\ \left(\frac{L}{ha}\right) = \frac{Spray\ bandwidth\ (m)}{Nozzle\ spacing\ (m)} \times Broadcast\ spray\ rate\ \left(\frac{L}{ha}\right)$$

If the spray rate is very low, there is a good change that the nozzle may not work optimally. This can be rectified by diluting the fertilizer with water, hence increasing the nozzle flow rate without applying too much fertilizer to the field. If a nozzle is available that can function properly at the required nozzle flow rate, then an option is to replace the nozzle with a type that matches the required flow rate.

Nozzle manufacturers publish tables matching nozzle types to field application rates. Hence our approach will be to estimate the lowest and highest field application rates and see, if nozzles are available for this range. Sunflower and wheat are examples of crops with low and high spray rates.

Table 26. Spray rates for a 30-8-10 liquid NPK fertilizer applied to wheat and sunflower.

					Wheat		Sunflower	
Concentration			1.301	kg/L	kg/ha	L/ha	kg/ha	L/ha
N	0.3	kg/kg	0.390	kg/L	240	615	60	154
P	0.08	kg/kg	0.104	kg/L	82	788	29	279
K	0.1	kg/kg	0.130	kg/L	143	1099	18	138

Table 26 shows that the spray rate for liquid fertilizer range from 138 to 1100 Liters/ha.

Table 27. Field application rates of liquid fertilizers for a given nozzle type[2].

		l/ha at km/h								
bar	l/min	4	5	6	7	8	9	10	12	16
1.0	1.86	558	446	372	319	279	248	223	186	139
1.5	2.28	683	546	455	390	341	303	273	228	171
2.0	2.63	788	631	526	451	394	350	315	263	197
3.0	3.22	966	773	644	552	483	429	386	322	241
4.0	3.72	1115	892	743	637	558	496	446	372	279
5.0	4.16	1247	997	831	712	623	554	499	416	312
		Large drop flat spray nozzle (371551) + 1553-20 Grey (370075)								

Table 27 show that we can obtain the range of field spray rate by adjusting the velocity of the tractor and by adjusting the nozzle spray rate. There is therefore no need to dilute liquid fertilizers.

Nevertheless, the script provides a parameter (`RN.liqfertDilutionFactor`) to set the dilution factor. In version 1.1.3 and later, `RN.liqfertDilutionFactor = 1`.

[2] http://hardi-international.com/sprayers/sprayer-components/nozzles

Each time you spray a field, you will have to look up the spray rate based on the crop type and the spray type. For cow manure on a barley field the spray rate in VariableSprayUsage should be set to $31\frac{m^3}{ha}$, while for pig manure it should be set to $18\frac{m^3}{ha}$. The log file contains similar information for all other fruit types on the map.

6.4 Lime application

Lime is spread to raise the pH of the soil. How much to spread depends on (1) how much the pH needs to be raised, (2) on the soil type, and (3) on the lime source. The script allows the user to define these parameters:

```
RN.soilType =         2;
RN.soilCurrentpH =    6;   -- determinant for lime application rate
RN.soilTargetpH =   6.7;   -- determinant for lime application rate
RN.limeNV =          50;   -- "Neutralizing Value, Ground limestone = 50
-- 1: Sands and loamy sands: 2: Sandy loams and silt loam; 3: Clay loams and clay
```

Precision Farming.

This mod will automatically determine the application rate of lime based on the pH value of the soil and the desired target value.

6.5 Herbicide application

Herbicides are sprayed to kill weeds. In this script, the default amount is 2 kg/ha, but this can be changed by the mod user. Herbicides are usually diluted with water and sprayed with a liquid fertilizer sprayer. In the script, the default dilution is set by the parameter:

```
RN.herbicideDilutionFactor = 200; -- 1 liter of herbicide to 200 liter of water
```

The price of herbicide is reduced accordingly. So, if you fill a sprayer with a tank of 2000 L, there is only 10 L of concentrated herbicide product in the tank. Your cost of filling the 2000 L tank with diluted herbicide then equals the cost of 10 L concentrated herbicide product (ignoring the cost of water).

7 Crop yield

Pressing lAlt-ry we obtain a list of crop yields.

Table 28. Crop yield under optimal conditions.

ALFALFA max yield	=	39072	L/Ha
BARLEY max yield	=	5977	L/Ha
CABBAGE max yield	=	99238	L/Ha
CANOLA max yield	=	2640	L/Ha
CARROT max yield	=	75423	L/Ha
CLOVER max yield	=	51282	L/Ha
COFFEE max yield	=	2228	L/Ha
COTTON max yield	=	5522	L/Ha
DECOFOLIAGE max yield	=	24000	L/Ha
DRYALFALFA max yield	=	32849	L/Ha
DRYCLOVER max yield	=	47348	L/Ha
DRYGRASS max yield	=	51553	L/Ha
GRASS max yield	=	55177	L/Ha
HEMP max yield	=	3475	L/Ha
HOPS max yield	=	2288	L/Ha
LETTUCE max yield	=	108299	L/Ha
MAIZE max yield	=	15617	L/Ha
MILLET max yield	=	2924	L/Ha
MUSTARD max yield	=	1151	L/Ha
OAT max yield	=	5811	L/Ha
OILSEEDRADISH max yield	=	3563	L/Ha
ONION max yield	=	79064	L/Ha
POPLAR max yield	=	28200	L/Ha
POPPY max yield	=	11600	L/Ha
POTATO max yield	=	51107	L/Ha
REDCABBAGE max yield	=	99238	L/Ha
RICE max yield	=	15262	L/Ha
RYE max yield	=	2734	L/Ha
SOYBEAN max yield	=	4510	L/Ha
SUGARBEET max yield	=	50886	L/Ha
SUGARCANE max yield	=	115743	L/Ha
SUNFLOWER max yield	=	3883	L/Ha
TOBACCO max yield	=	3170	L/Ha
WEED max yield	=	0	L/Ha
WHEAT max yield	=	5952	L/Ha
Alfalfa silage max yield	=	37118	L/Ha
Clover silage max yield	=	48718	L/Ha
Grass silage max yield	=	52418	L/Ha

The yields assume that optimal field conditions are in place. I.e., that the field has been plowed, fertilized, and weeded as required.

8 Commodity prices

In Farming Simulator, the purchase price of farmland is very high. Much higher than in real life. The script **RealNumbersCommodityPrices** allows you to set the farmland price to a realistic value.

Taking a loan is easy in Farming Simulator. With a default interest rate of 300% it might not be easy to pay back the loan. The script sets the interest rate at 4% and a max loan amount to 3 mill. €. Both can easily be changed.

For some countries, this information is confidential and therefore not included in EUROSTAT documents. The price per hectare varies considerably due to local differences in national laws (regulating foreign ownership), regional differences in climate and agricultural infrastructure as well as local variations in soil quality, drainage, and terrain elevation.

8.1 Cost of common farm supplies

It is very common that farmers rent farmland from other farmers. While this is not a standard feature in Farming Simulator, it is accomplished in this script by assigning lower prices to some fields. The price for renting farmland in EU and USDA farming regions are listed in Table 30 and Table 31. In EU, the ratio of rent-to-purchase varies from 0.01 to about 0.05, with an average of 0.025, or 2.5% of the purchase price. This would be a good second guess if playing a map in a country where farmland rent prices is confidential.

Table 29. Purchase price for farmland in EU. €/ha.

	2011	2012	2013	2014	2015	2016	2017
Belgium							
Bulgaria	2112	2843	3175	3620	3891	4131	4622
Czech Republic	1836	3264	3662	4282	4775	5463	6462
Denmark	17476	17562	15708	17209	18752	17584	17328
Germany							
Estonia	1062	1265	1865	2426	2567	2735	2890
Ireland			26366	23449	23594	18141	19903
Greece	15393	14968	13907	13276	12633	12528	12627
Spain		12005	11910	12192	12574	12522	12827
France	5390	5440	5770	5940	6000	6070	6030
Croatia					2726	2835	3005
Italy	34257	39342	32532	39247	40153	28985	33538
Cyprus							
Latvia	2336	4475	4980	2552	2654	2917	2975
Lithuania	1212	1527	2009	2330	3089	3516	3571
Luxemburg	23648	24230	26621	27438	27738	26030	35590
Hungary	2089	2380	2709	3042	3356	4182	4368
Malta							
Netherland	50801	52716	54134	56944	61400	62972	68197
Austria							
Poland	4855	6080	6275	7723	9220	9083	9699
Portugal							
Romania	1366	1666	1653	2423	2039	1958	2085
Slovenia			15545	16009	16071	17136	16876
Slovakia							
Finland	8210	8047	8461	8090	8138	8326	8718
Sweden	6811	7043	6797	7408	7751	7921	8708
United Kingdom	18885	21905	23283	26634	30464	25999	23450

Table 30. Rent price per year in EU. €/ha.

	2011	2012	2013	2014	2015	2016	2017
Belgium							
Bulgaria	153	174	194	210	215	225	240
Czech Republic	56	61	66	73	87	96	104
Denmark	534	562	555	535	518	536	539
Germany							
Estonia	26	35	40	48	52	52	58
Ireland			258	255	269	290	295
Greece	549	544	460	435			
Spain		134	136	138	140	144	148
France	139	145	155	167	184	202	215
Croatia			73	67	73	74	69
Italy							
Cyprus							
Latvia	57	67	71	38	43	46	57
Lithuania	56	66	78	80	80	81	99
Luxembourg				220	233	240	244
Hungary	107	126	129	131	139	151	160
Malta							
Netherlands	624	653	683	720	749	794	847
Austria	260	264	270	276	281	285	288
Poland							
Portugal							
Romania							
Slovenia							
Slovakia	37	37	39	44	44	50	
Finland	191	213	210	223	225	226	229
Sweden	168	176	180	174	160	160	
United Kingdom	214	238	212	237	245	224	

Table 31. Rent prices on farmland in USDA regions. $/ha. Averaged over 2016--2018.

USDA Regions	$/ACRE	$/ha
Delta Region	97	240
Eastern Mountain Region	87	214
Great Lakes Region	157	388
Heartland Region	156	386
Mountain Region	97	239
North Eastern Region	81	200
Northern Plains Region	96	238
Northwest Region	170	421
Pacific Region	267	659
Southern Plains Region	37	91
Southern Region	96	236
Upper Midwest Region	180	444
US average	**127**	**313**

The parameters for purchasing and renting farmlands are defined in **RealNumbersInitialization**.

```
RN.annualLoanInterest          =       4;     -- Annual interest rate on loans
RN.loanMax                     = 3000000;     -- Max loan
RN.pricePerHa                  =   25000;     -- GEO DE, purchase price of farmland per hectare
RN.rentPricePerHa              = 0.025 * RN.pricePerHa;      -- rent price of farmland per ha
RN.gameDayOfYearRentTerminates = 1;   -- Game day of the year when field rent terminates

RN.rentedFields        =  { 3,  5,  7,  9, 11, 13, 15, 17, 21, 23, 25, 29,
                           31, 33, 35, 37, 41, 43, 45, 47, 51, 53, 55, 57,
                           61, 63, 65, 67, 71, 73, 75, 77, 81, 83, 85, 87};
```

The list of rentable farmlands can be changed. I have randomly chosen 4 out of 10 farmlands to be rentable. The list can be extended or shortened as needed. Notice, the variable is called RN.rentedFields. In reality it is rented farmland. Hence the numbers do not match field numbers. Press lAlt-rf or lAlt-rt to get a list of fields or farmlands, and see in these lists, which fields can be rented. lAlt-rg will list only lands owned or rented.

The purchase price of a number of commodities are listed in Table 32. Herbicide and fertilizers are expensive. For herbicide, the purchase price of pure substance has been reduced by typical sprayer dilution factors as mentioned in the section on spraying.

A small random day-by-day variation is installed in commodity prices:

```
RN.commodityPriceVariation = 10;    -- price fluctuation in percentage
```

Table 32. Example commodity prices (Germany).

```
Annual interest rate                   =       4     %
Max loan                               =   3000000   €
Farmland purchase price Per Ha         =     25000   €/ha
Farmland rent price Per Ha             =       625   €/ha

APFEL fillTypeIndex                    =      99
APFEL massPerLiter                     =      0.3000  kg/L
RandomPriceFactor                      =      0.9990
APFEL price                            =     152     €/1000 L

BIRNE fillTypeIndex                    =     102
BIRNE massPerLiter                     =      0.3000  kg/L
RandomPriceFactor                      =      0.9622
BIRNE price                            =     165     €/1000 L

CHAFF fillTypeIndex                    =      21
CHAFF massPerLiter                     =      0.1750  kg/L
RandomPriceFactor                      =      0.9551
CHAFF price                            =      40     €/1000 L

COMPOST fillTypeIndex                  =      92
COMPOST massPerLiter                   =      0.6000  kg/L
RandomPriceFactor                      =      1.0210
COMPOST price                          =      30     €/1000 L

DIESEL fillTypeIndex                   =      32
DIESEL massPerLiter                    =      0.8400  kg/L
RandomPriceFactor                      =      1.0263
DIESEL price                           =     940     €/1000 L

DIGESTATE fillTypeIndex                =      47
DIGESTATE massPerLiter                 =      0.9000  kg/L
RandomPriceFactor                      =      0.9686
DIGESTATE price                        =       3     €/1000 L

ERDE fillTypeIndex                     =      96
ERDE massPerLiter                      =      0.3900  kg/L
RandomPriceFactor                      =      0.9507
ERDE price                             =     190     €/1000 L

FERTILIZER fillTypeIndex               =      43
FERTILIZER massPerLiter                =      0.8000  kg/L
RandomPriceFactor                      =      1.0254
FERTILIZER price                       =     388     €/1000 L
```

The purchase price of store commodities, such as bales, big bags and pallets are reduced to values typical for the country/USDA region, and the prices are made to fluctuate randomly. For this reason, there will be small differences in the prices of round and square bales.

Figure 8. Modified store prices on pallets.

Figure 9. Not everything costs money. Sometimes you are lucky. Oberlausitz map by RitchiF.

8.2 Some running costs.

Some daily running costs can now be adjusted. **Vehicle Running Cost** is controlled by the three mod parameters:

```
RN.maintenanceCostPercentage                    = 0.5;
RN.heavyUseMaintenanceFactor                    = 1.5;
RN.equipmentInsurancePercentage                 = 0.2;
```

The first factor sets the running cost to 0.5% of the total money value of owned equipment (vehicles, trailers, implements, tools, etc.). In case an item is used more than 3 hours per day, the cost is scaled by a factor 1.5 (50% more than base cost). Insurance costs are added to this cost. It is set to 0.2% of the total value of the equipment. The mod calculates the total annual cost and divides by the number of game days per year.

Property Maintenance Cost can also be adjusted. It is controlled by the parameter:

```
RN.propertyMaintenanceCostPercentage            = 0.5;
```

The mod sums up the total value of buildings, silos, placeables etc. and sets the annual maintenance cost at 0.5%. To set the cost per game day, the mod divides the annual cost by the number of game days per year. For this to work the mod sets the in-game parameter dailyUpkeep = 0.

There is also a **daily cost of animal upkeep**. The annual upkeep per animal is obtained slightly different for the different animals due to different principles used in the data sources.

PIGS:

```
RN.variableCost["PIG"]             = 0.324;     -- GEO - DE, € per kg carcas
RN.labourCost["PIG"]               = 0.156;     -- GEO - DE, € per kg carcas
RN.financeCost["PIG"]              = 0.252;     -- GEO - DE, € per kg carcas
RN.carcasWeight["PIG"]             = 94;        -- GEO - DE, kg
RN.liveSlaughterWeight["PIG"]      = 122;       -- GEO - DE, kg
RN.annualUpkeepPerAnimal["PIG"]    = RN.carcasWeight["PIG"] *
(RN.variableCost["PIG"]+RN.labourCost["PIG"]+RN.financeCost["PIG"]);
```

For pigs, the cost parameters are based of carcass weight. The costs exclude feed and water, but includes health and veterinary services, labor cost and finance costs (unknown type).

COWS:

```
RN.variableCost["COW"]             = 45;        -- GEO - UK, €
RN.labourCost["COW"]               = 175;       -- GEO - UK, €
RN.financeCost["COW"]              = 0;         -- GEO - UK, €
RN.annualUpkeepPerAnimal["COW"]    =
(RN.variableCost["COW"]+RN.labourCost["COW"]+RN.financeCost["COW"]);
```

For cows the cost is based on rearing heifers until 1 year old.

SHEEP:

```
RN.variableCost["SHEEP"]           = 21;        -- GEO - US, €
RN.labourCost["SHEEP"]             = 10;        -- GEO - US, €
RN.financeCost["SHEEP"]            = 5;         -- GEO - US, €
RN.annualUpkeepPerAnimal["SHEEP"]       =
(RN.variableCost["SHEEP"]+RN.labourCost["SHEEP"]+RN.financeCost["SHEEP"]);
```

GOATS:

```
RN.variableCost["GOAT"]          = 100;       -- GEO - psu.edu €
RN.labourCost["GOAT"]            = 150;       -- GEO - psu.edu €
RN.financeCost["GOAT"]           = 63;        -- GEO - TEAGASC, €
RN.annualUpkeepPerAnimal["GOAT"] =
(RN.variableCost["GOAT"] + RN.labourCost["GOAT"] + RN.financeCost["GOAT"]);
```

Goats are here assumed to be dairy goats. Compared to sheep, they are a lot more labor intensive and much more expensive in terms of housing, milking equipment, and care.

To get an overview of running costs press lAlt-re:

Table 33. Annual costs of equipment, property and animal upkeep. Press lAlt-re

Total value of equipment	=	2554599	€
Total maintenance of equipment	=	17882	€/year
Total value of properties	=	3139500	€
Total maintenance of properties	=	15698	€/year
Total animal upkeep	=	8613	€/year

To get an overview of the number of animals and animal upkeep costs press lAlt-ra.

Table 34. Number of animals and their upkeep cost. Press lAlt-ra.

Current number of cows	=	20	
Annual upkeep: cows	=	4400	€/year
Current number of calves	=	14	
Annual upkeep: calves	=	2380	€/year
Current number of pigs	=	12	
Annual upkeep: pigs	=	363	€/year
Current number of sheep	=	34	
Annual upkeep: sheep	=	1224	€/year
Current number of goats	=	20	
Annual upkeep: goats	=	6260	€/year
Current number of chickens	=	36	
Annual upkeep: chickens	=	360	€/year
Current number of ducks	=	20	
Annual upkeep: ducks	=	400	€/year
Current number of horses	=	1	
Annual upkeep: horses	=	400	€/year

Notice that the upkeep of animals will increase gradually when mature animals start giving birth.

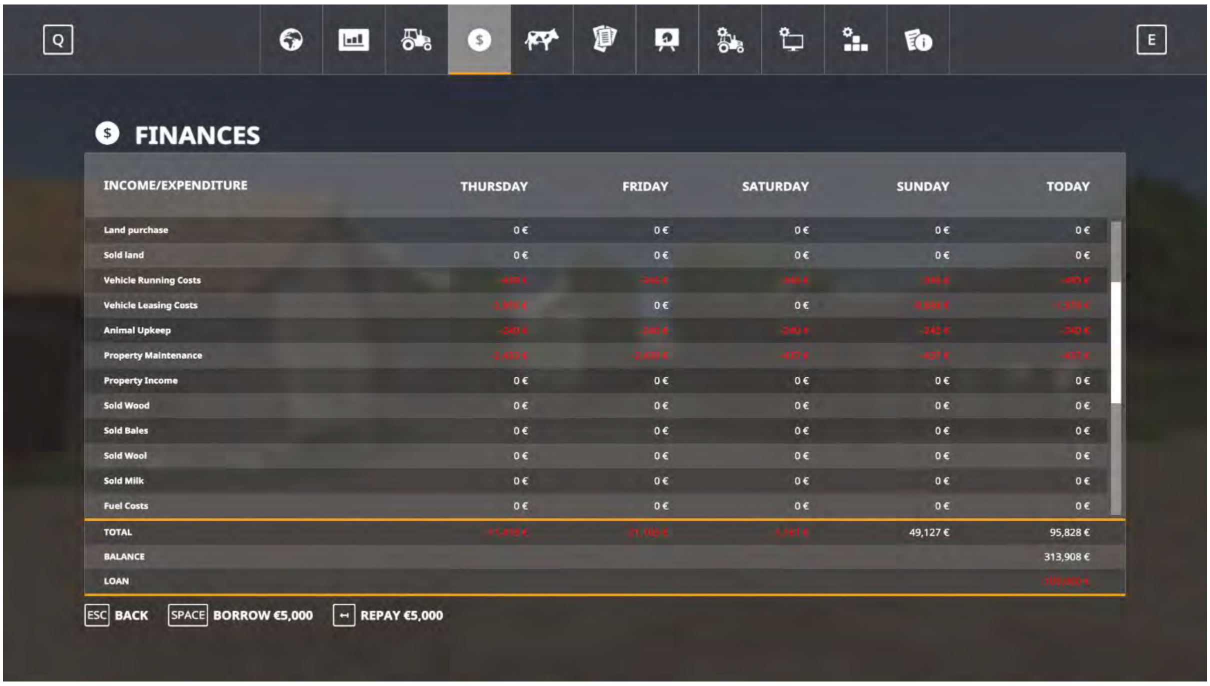

Figure 10. Adjusted vehicle running/leasing costs, property maintenance, and animal upkeep.

9 Leasing equipment

The cost of leasing equipment is very high in Farming Simulator. The in-game default cost is divided into three components, all percentages of the purchase price: a 2% lease initiation fee, 1 % daily fee, and an hourly fee of 2.1%. Let us consider as an example that we have 4 ha of sugar beet to harvest. According to Table 56, the crop net income will be 220 € depending on your map location. Let us assume that we can harvest the field within 2 hours if we use the big Holmer self-propelled sugar beet harvester. It costs about 500,000 €, hence the cost of leasing for two hours will be (2+2.1+2.1+1= 7.2%) 36,000 €, much higher than the expected real-life harvest income. In Denmark, the rate of hiring a contractor for beet harvesting is about 290 €/ha.

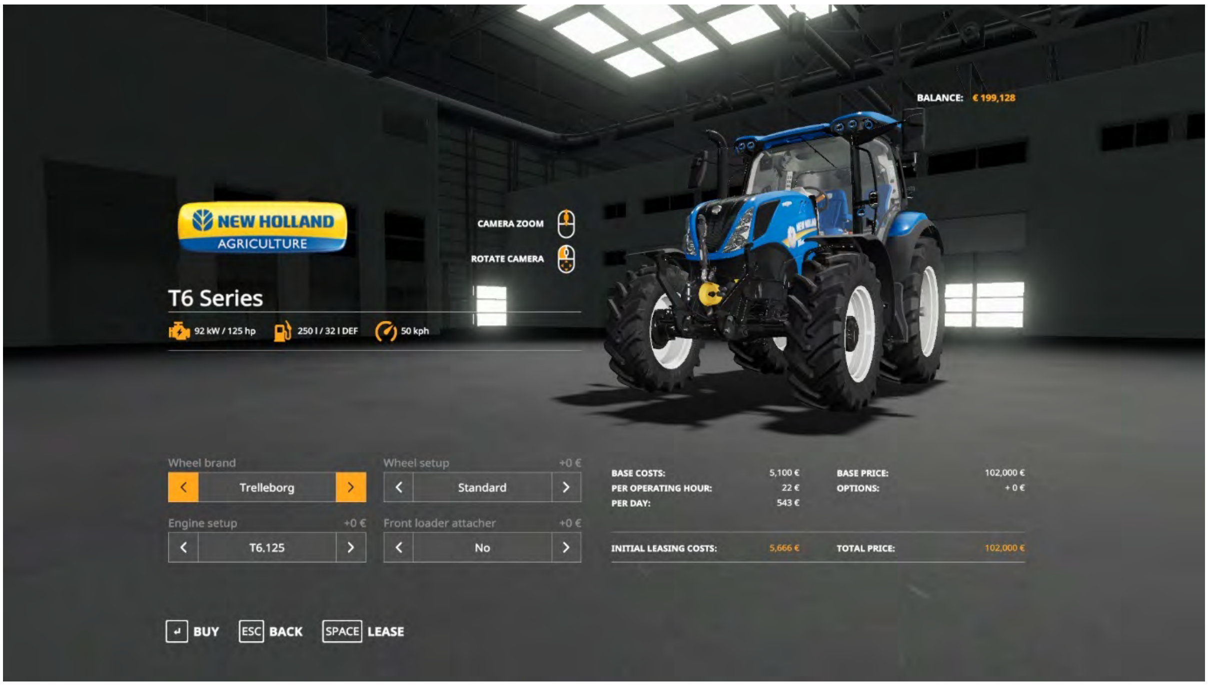

Figure 11. Reduced leasing cost on tractor.

The script **RealNumbersLeasing.lua** presents the mod user with the option of choosing different models for long-term and short-term leasing. By long-term leasing we understand a situation where the farmer leases equipment as an alternative to buying. By short-term leasing we understand day-by-day leasing, where it resembles hiring a contractor to seed or harvest your fields.

For long-term leasing the user has the option of designing their own leasing contracts (see Figure 11 and Table 35).

Table 35. Equipment leasing contract.

Contract parameters		Contract items	Value
Equipment lifetime (years)	6	Equipment value (example)	100000
Equipment lifetime (months)	72	End time value	37715
Annual value loss factor	0.15	Initial installment	5000
Annual Interest factor	0.05	Base loan	57285
Initial installment factor	0.05	Loan interest	19482
Calculated values		Total loan	76767
Per gameday pay factor	0.5331	Installment per gameday	533
Per gamehour pay factor	0.0222	Installment per gamehour	22

The contract example shown in Table 35 has a 5% initial installment. This may produce realistic values for a long-term lease but will make the cost very high in the case of a “one-day” lease.

Figure 12. Reduced lease on sugar beet harvester.

Figure 13. A dealer with equipment on display. Felsbrunn map.

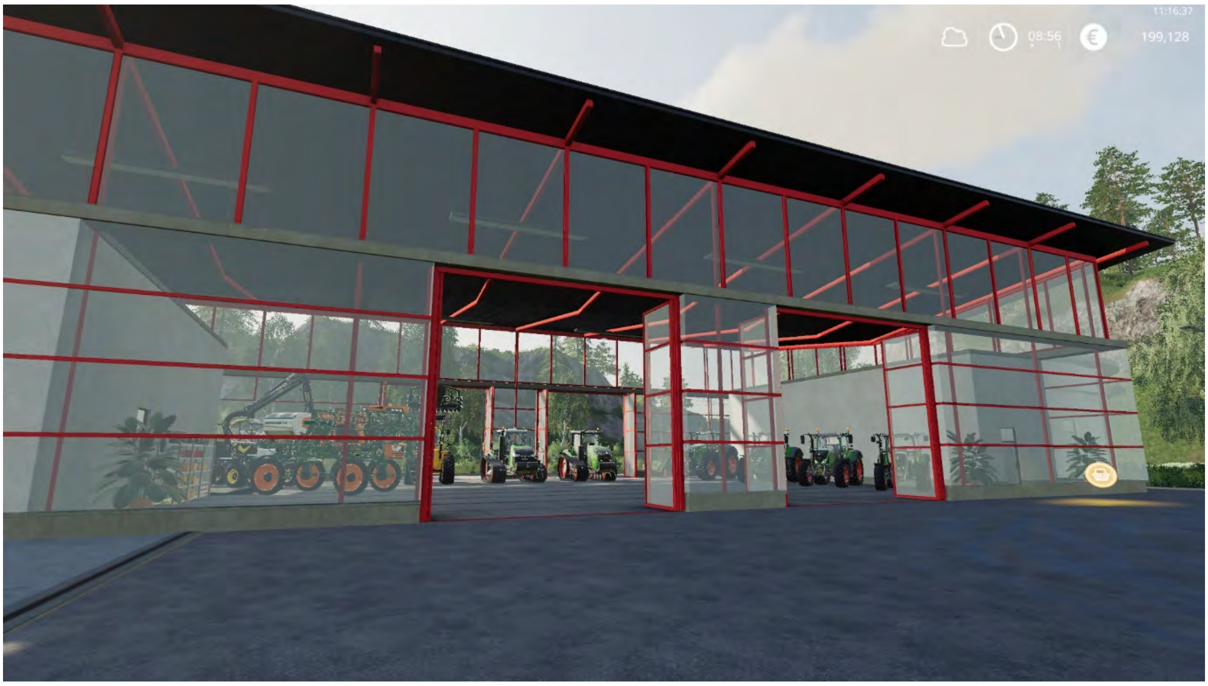

Figure 14. No cardboard tractors at this dealer. Felsbrunn.

The objective of RealNumbersLeasing is to make leasing a viable alternative to buying. The leasing model presented above is useful for long-term leasing. For day-by-day leasing the deposit and daily lease is much too high.

As mentioned earlier, day-by-day leasing of special equipment, such as harvesters, can be interpreted as hiring a contractor. Putting a helper on the leased equipment completes this role play. Large-scale root-crop farmers often hire a contractor to harvest their root crop. The farmer may assist by carting the crops to storage.

Personally, I enjoy maps with multifruits, in particular vegetable crops. In this case you would need to rent different headers for each vegetable crop, which would be very expensive using the long-term lease model.

Consequently, the mod user who wants to lease equipment on a day-by-day basis will have to use a short-term lease model. This is done by setting the parameter RN.leaseMode to zero in the script RealNumbersInitialization.lua.

```
RN.leaseMode = 0;

RN.leasePerHourScale = 1.0; -- Scales the lease per hour (default = 1)
```

These parameters are used in the script RealNumbersLeasing.lua to scale the per day leasing factor and the deposit factor.

If you prefer long-term leasing, set `RN.leaseMode = 1`.

Unfortunately, the same lease per hour scale factor must be used for all equipment. Hence the lease cost is a fixed fraction of the purchase price and cannot be set individually for each piece of equipment.

When doing day-by-day leasing, the game time scale should be set to one. If not, you get less work done for the same cost.

Figure 15. Home delivery?!?

10 Field information

Different countries do different types of farming. In Table 36 it is seen that 98.5% of all farmland is arable land in Finland, whereas 79% of all farmland is grassland in Ireland.

Table 36. Farmland type distribution in percentage in EU.

	Arable land	Permanent grassland and meadow	Permanent crops	Other
EU-28	59.8	34.2	5.9	0.2
Finland	**98.5**	1.4	0.2	0.0
Denmark	91.5	7.5	1.0	0.0
Sweden	85.1	14.8	0.2	0.0
Hungary	81.6	15.1	3.0	0.3
Lithuania	79.6	19.6	0.8	0.0
Malta	78.8	0.0	11.6	9.7
Poland	74.7	22.3	2.9	0.2
Cyprus	73.3	1.7	**25.0**	0.0
Slovakia	71.7	27.3	1.0	0.0
Czech Republic	71.4	27.5	1.1	0.0
Germany	71.1	27.7	1.2	0.0
Bulgaria	70.5	27.3	2.0	0.1
France	66.6	29.7	3.7	0.0
Estonia	65.6	33.9	0.4	0.1
Latvia	64.1	34.8	0.4	0.7
Romania	62.8	33.7	2.3	1.2
Belgium	61.1	37.2	1.7	0.0
Netherlands	56.2	41.8	2.0	0.0
Croatia	55.9	39.3	4.6	0.1
Italy	55.6	27.4	16.8	0.2
Austria	50.0	47.5	2.4	0.1
Spain	48.5	34.2	17.3	0.0
Luxembourg	47.8	51.1	1.2	0.0
Greece	37.4	43.3	19.1	0.2
United Kingdom	36.7	63.1	0.2	0.0
Slovenia	35.6	58.6	5.6	0.2
Portugal	30.2	49.9	19.5	0.4
Ireland	21.0	**79.0**	0.0	0.0

The average farmland area of farms in EU is shown in Figure 16.

Having obtained information about how much field area is required for a certain number of animals, the script **RealNumbersFieldInfo** provides information about farmlands and fields, their size and price, their crop, their ownership status and if the field can be bought or rented (Table 37).

The purchase or rent price is determined by the hectares of farmland, not the hectares of the field. When a fruit type is undefined, no crop is growing on the field at this moment. The column showing ownership status has four possibilities: for sale, for rent, owned or rented. Pressing **lAlt-rd** will display how many days are left in the field rent year.

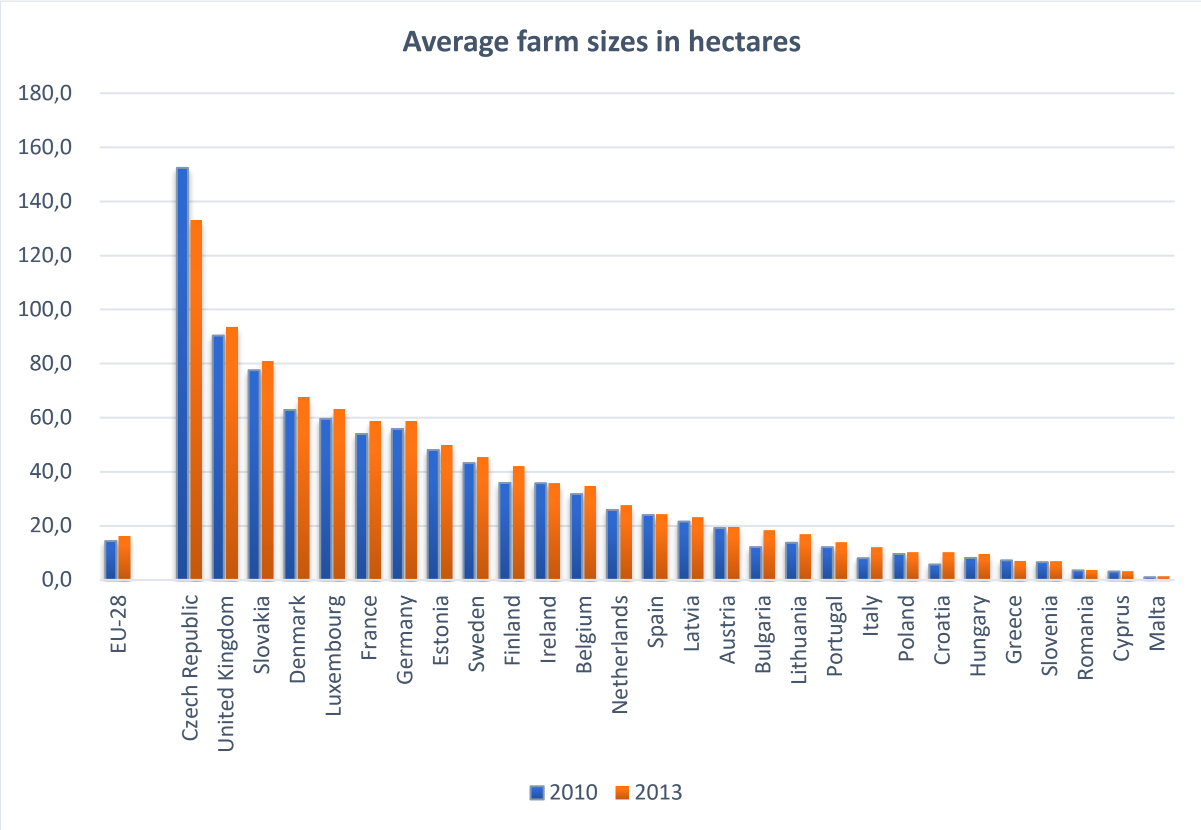

Figure 16. Average land area on farms in EU.

Table 37. Field information for a map. You pay for land area, not field area. Press lAlt-rf.

```
Mean land purchase price = 25000 €/ha
Mean land rent price = 625 €/ha
Field  1: Landarea =  6.3 ha, Fieldarea =  2.3 ha, Price =  157859 €,  For sale, Fruittype: Soybean
Field  2: Landarea =  4.8 ha, Fieldarea =  2.2 ha, Price =  116876 €,  For sale, Fruittype: Barley
Field  3: Landarea =  5.1 ha, Fieldarea =  1.6 ha, Price =  126710 €,  For sale, Fruittype: Grass
Field  4: Landarea =  7.9 ha, Fieldarea =  1.6 ha, Price =  188180 €,  For sale, Fruittype: Barley
Field  5: Landarea =  4.6 ha, Fieldarea =  1.0 ha, Price =    2931 €,  For rent, Fruittype: Undefined
Field  6: Landarea = 14.2 ha, Fieldarea =  5.2 ha, Price =  364945 €,  Owned   , Fruittype: Wheat
Field  7: Landarea =  8.4 ha, Fieldarea =  3.8 ha, Price =  216774 €,  Owned   , Fruittype: Barley
Field  8: Landarea =  5.5 ha, Fieldarea =  2.6 ha, Price =  136271 €,  For sale, Fruittype: Sugarbeet
Field  9: Landarea =  4.9 ha, Fieldarea =  3.0 ha, Price =    2998 €,  Rented  , Fruittype: Barley
Field 10: Landarea =  8.8 ha, Fieldarea =  5.2 ha, Price =  226029 €,  Owned   , Fruittype: Sunflower
Field 11: Landarea =  3.2 ha, Fieldarea =  2.1 ha, Price =   81448 €,  Owned   , Fruittype: Wheat
Field 12: Landarea =  7.6 ha, Fieldarea =  5.6 ha, Price =  197587 €,  For sale, Fruittype: Undefined
Field 13: Landarea =  5.1 ha, Fieldarea =  4.1 ha, Price =  132828 €,  For sale, Fruittype: Undefined
Field 14: Landarea =  6.7 ha, Fieldarea =  3.9 ha, Price =    4268 €,  Rented  , Fruittype: Oat
Field 15: Landarea =  3.8 ha, Fieldarea =  1.3 ha, Price =   96010 €,  For sale, Fruittype: Wheat
Field 16: Landarea = 10.1 ha, Fieldarea =  4.8 ha, Price =    6202 €,  For rent, Fruittype: Barley
Field 17: Landarea =  4.4 ha, Fieldarea =  3.0 ha, Price =  106361 €,  Owned   , Fruittype: Wheat
Field 18: Landarea =  3.0 ha, Fieldarea =  2.0 ha, Price =   73283 €,  For sale, Fruittype: Undefined
Field 19: Landarea =  2.9 ha, Fieldarea =  1.6 ha, Price =   72262 €,  For sale, Fruittype: Undefined
Field 20: Landarea =  3.0 ha, Fieldarea =  0.7 ha, Price =    1887 €,  For rent, Fruittype: Undefined
Field 21: Landarea =  4.7 ha, Fieldarea =  2.4 ha, Price =  111652 €,  Owned   , Fruittype: Grass
Field 22: Landarea =  6.7 ha, Fieldarea =  3.8 ha, Price =  161355 €,  Owned   , Fruittype: Grass
Field 23: Landarea =  7.4 ha, Fieldarea =  2.2 ha, Price =    4439 €,  For rent, Fruittype: Undefined
Field 24: Landarea =  4.9 ha, Fieldarea =  1.3 ha, Price =  121884 €,  For sale, Fruittype: Undefined
Field 25: Landarea =  2.6 ha, Fieldarea =  0.7 ha, Price =   62971 €,  For sale, Fruittype: Canola
Field 26: Landarea =  2.1 ha, Fieldarea =  1.2 ha, Price =   52968 €,  Owned   , Fruittype: Grass
Field 27: Landarea =  3.4 ha, Fieldarea =  1.7 ha, Price =   86656 €,  Owned   , Fruittype: Barley
Field 28: Landarea =  1.8 ha, Fieldarea =  0.6 ha, Price =    1070 €,  Rented  , Fruittype: Potato
Field 29: Landarea =  2.1 ha, Fieldarea =  0.5 ha, Price =   53019 €,  For sale, Fruittype: Undefined
Field 30: Landarea =  3.0 ha, Fieldarea =  1.6 ha, Price =   75270 €,  Owned   , Fruittype: Grass
Field 31: Landarea =  3.7 ha, Fieldarea =  1.6 ha, Price =   93322 €,  For sale, Fruittype: Undefined
Field 32: Landarea =  3.4 ha, Fieldarea =  1.0 ha, Price =    2044 €,  For rent, Fruittype: Undefined
Field 33: Landarea =  4.5 ha, Fieldarea =  1.2 ha, Price =  115395 €,  For sale, Fruittype: Sunflower
```

All field rent contracts are terminated on the same day, defined as the *rent termination day*. By default, this is on the first day of mid-winter. ***On that day, rent prices are set to zero and all attempts to rent fields are cancelled. On the following day, rent contracts can be renewed or new fields can be rented***. Rented fields can be sold with a reimbursement corresponding to the rest of the rent cost for that rent year.

To have an idea about how much field work lies ahead, Table 38 sums up the hectares of different crop groups. This helps deciding the size of headers for your harvester and width of implements such as ploughs, cultivators and seeders. Compare what you own with what you need by also pressing lAlt-ra to see required crop hectares for your herd size.

The present script needs to delay its execution until the map loading has completed. For this reason, this script is **only run when the user presses lAlt-rf**, i.e. the left Alt key is held down while pressing r and f simultaneously.

Table 38. Summary of feed crop area on farm.

```
Total farmland area owned/rented        =      78.0  Ha
Total field area owned/rented           =      39.5  Ha
Grain crop area                         =      14.0  Ha
Protein crop area                       =       5.2  Ha
Maize area                              =       2.9  Ha
Potato area                             =       1.4  Ha
Sugarbeet area                          =       0.0  Ha
Grass area                              =       1.7  Ha
```

On some maps, several fields are grouped into one farmland, and all fields in the group must be purchased or rented. An example of this concept is seen on the Eire map (see Table 39).

Table 39. Alternative field listing organized in farmland groups. Press lAlt-rt to get this view.

```
Farmland   1: Land area =  2.8 ha,  Price =   70432 €, Ownership:  For sale
              Field  41: Field area =  0.3 ha,   Fruit: REDCABBAGE
              Field  42: Field area =  0.6 ha,   Fruit: Undefined
Farmland   2: Land area =  1.6 ha,  Price =   40058 €, Ownership:  For sale
              Field  40: Field area =  1.6 ha,   Fruit: Undefined
Farmland   3: Land area =  2.3 ha,  Price =   53939 €, Ownership:  For sale
              Field  39: Field area =  0.9 ha,   Fruit: Undefined
Farmland   4: Land area =  2.8 ha,  Price =   70172 €, Ownership:  For sale
              Field  24: Field area =  2.0 ha,   Fruit: Undefined
Farmland   5: Land area =  3.8 ha,  Price =    1507 €, Ownership:  For rent
              Field  23: Field area =  2.0 ha,   Fruit: POTATO
              Field  33: Field area =  1.4 ha,   Fruit: Undefined
Farmland   6: Land area =  3.5 ha,  Price =   89787 €, Ownership:  Owned
              Field  32: Field area =  1.9 ha,   Fruit: Undefined
              Field  34: Field area =  1.3 ha,   Fruit: CABBAGE
Farmland   7: Land area =  4.1 ha,  Price =  102113 €, Ownership:  For sale
              Field  21: Field area =  1.9 ha,   Fruit: Undefined
              Field  22: Field area =  1.6 ha,   Fruit: Undefined
Farmland   8: Land area =  1.9 ha,  Price =   48397 €, Ownership:  For sale
              Field  25: Field area =  0.6 ha,   Fruit: Undefined
              Field  26: Field area =  0.7 ha,   Fruit: SUGARBEET
Farmland   9: Land area =  4.6 ha,  Price =    1945 €, Ownership:  Rented
              Field  30: Field area =  2.3 ha,   Fruit: LETTUCE
              Field  31: Field area =  1.7 ha,   Fruit: Undefined
Farmland  10: Land area =  6.0 ha,  Price =  141986 €, Ownership:  For sale
              Field  36: Field area =  3.9 ha,   Fruit: Undefined
              Field  37: Field area =  2.0 ha,   Fruit: Undefined
```

On these maps an alternative listing is required, showing how fields are grouped, and what fields are rentable. In Table 39, farmlands 5 and 9 are rentable. Hence fields 30 and 31 are rented in one group and fields 41 and 42 are rented in another group.

A field will have an **undefined fruit type** if it has been plowed or cultivated after harvest. Normally, the fruit type will be redefined when the field is reseeded. However, on some multifruit maps, the fruit type remains undefined after being reseeded with a non-standard fruit. The fruit type map will still show the correct fruit type color, but fruit type index is missing from the table defining fields.

Pressing lAlt-rg will print a list of land areas owned or rented.

Figure 17. Another day on the farm. Fenton Forest by Stevie.

Figure 18. Before an error causing an excessive production of wool was fixed.

11 Contracts

The script **RealNumbersContracts** attempts to turn the mission feature 180 degrees. In the default game, landowners offer odd jobs to the game player and pays out a predetermined award, which the game player then must accept or reject. The script **RealNumbersContracts** enables the game player to set up a Farming Contractor business and design contracts for a range of job types.
This script does not alter the cost of hired helpers. However, **Seasons** defines helper fees and may be changed by the player. *Changing a mod may interfere with multiplayer mode*.

In previous versions of the mod, contract fees were calculated based on hourly rates. This approach has been abandoned because most contractors work with a flat rate per hectare for the majority of contracting services.

Table 40. Contract fees in €/ha. Defined in the script RealNumbersEquipmentEconomy.lua.

```
        RN.contractRatePerHour["TRACTOR200HP"]        =  83;
        RN.contractRatePerHa.MANURESPREADER           = 130;
        RN.contractRatePerHa.SLURRYTANKS              = 130;
        RN.contractRatePerHa.PLOWS                    = 112;
        RN.contractRatePerHa.DISCHARROWS              =  35;
        RN.contractRatePerHa.CULTIVATORS              =  35;
        RN.contractRatePerHa.SEEDERS                  =  77;
        RN.contractRatePerHa.PLANTERS                 =  42;
        RN.contractRatePerHa.FERTILIZERSPREADERS      =  21;
        RN.contractRatePerHa.LIMESPREADERS            =  21;
        RN.contractRatePerHa.SPRAYERS                 =  28;
        RN.contractRatePerHa.WEEDERS                  =  19;
        RN.contractRatePerHa.HARVESTERS               = 165;
        RN.contractRatePerHa.FORAGEHARVESTERS         = 165;
        RN.contractRatePerHa.POTATOPLANTERS           = 195;
        RN.contractRatePerHa.POTATOHARVESTING         = 660;
        RN.contractRatePerHa.BEETHARVESTING           = 290;
        RN.contractRatePerHa.MOWERS                   =  65;
        RN.contractRatePerHa.TEDDERS                  =  22;
        RN.contractRatePerHa.WINDROWERS               =  22;
        RN.contractRatePerHa.SNOW                     = 100;
```

In some cases, contracts require the use of a single piece of equipment, such as a plow. In others is involves several pieces of equipment, such as mowing and baling.

For contracts like seeding, fertilizing, and spraying, the contractor delivers the seed, fertilizer and herbicide. As seen in the example contracts in Table 45, the cost of fertilizer and herbicide is frequently much higher than any other items on the contract. Consequently, the contractor should be reimbursed for such expenses. Although there is a “reimbursement” item on the screen when collecting the payment, this field seem always to be zero, even when the reimbursement variable has been assigned an appropriate value. For this reason, the RealLifeNumbers adds the reimbursement to the “reward” variable, such that full payment is secured.

Table 41. Example contracts. In multiplayer mode, this information is not shared with client computers.

cultivate field	=	10	
cultivate field area	=	0.7592	Ha
cultivate fertilizer state	=	0	%
cultivate lime state	=	0	%
cultivate herbicide state	=	100	%
cultivate plow state	=	100	%
cultivate yield factor	=	120	%
cultivate reward per ha	=	35.0000	€/Ha
cultivate total reward	=	26.5720	€
cultivate vehicle use cost	=	9.8129	€
cultivate total reimbursement	=	26.5720	€
fertilize field	=	37	
fertilize crop: BARLEY	=	2	
fertilize field area	=	2.9223	Ha
fertilize fertilizer state	=	0	%
fertilize lime state	=	100	%
fertilize herbicide state	=	100	%
fertilize plow state	=	100	%
fertilize yield factor	=	135	%
fertilize reward per ha	=	21.0000	€/Ha
fertilize total reward	=	61.3693	€
fertilize vehicle use cost	=	7.1685	€
fertilize fertilizer cost	=	210.9477	€
fertilize total reimbursement	=	272.3170	€
fertilize fertilizer liter/ha	=	214.1204	L/Ha
fertilize fertilizer cost/Liter	=	0.3260	€/L
fertilize fertilizer cost/ha	=	69.8075	€/Ha

For contracts like seeding, fertilizing, and spraying, the contractor delivers the seed, fertilizer and herbicide. As seen in the example contracts in Table 41, the cost of fertilizer and herbicide is frequently much higher than any other items on the contract. Consequently, the contractor should be reimbursed for such expenses. Although there is a "reimbursement" item on the screen when collecting the payment, this field seem always to be zero, even when the reimbursement variable has been assigned an appropriate value. For this reason, the RealLifeNumbers adds the reimbursement to the "reward" variable, such that full payment is secured.

For harvest contracts, FS19 pays the contractor a fraction of the sell price for the harvest. This will then be a bonus on top of the contract. Giants' motivation for this policy is unknown.

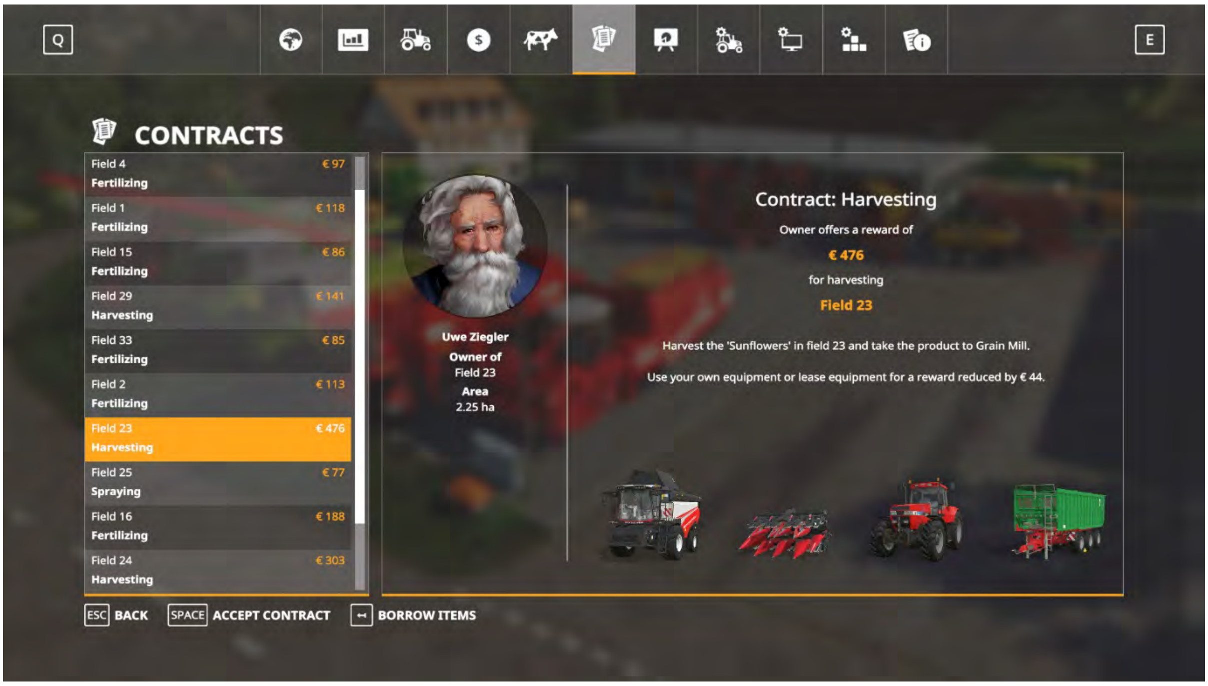

Figure 19. Contracts to be signed.

The contracting feature involves a lot of synchronization between host and clients when playing in multiplayer mode. The itemized contracts (Table 41) is not distributed to client PCs in RealLifeNumbers. Hence, client PCs will not get a list of itemized contracts when pressing lAlt-rc. Clients are still able to see the contracts in the in-game menu and will also be rewarded the amount setup in this mod.

12 Equipment economy

The objective of the new script RealNumbersEquipmentEconomy.lua is exclusively to provide information about how expensive it is to own a given equipment and if the cost of ownership exceeds the cost of hiring a contractor for the same job. The script does not control the gameplay, it only provides economic insight into your farming operation.

12.1 Tractors

Table 42. General parameters for calculating equipment cost. In RealLifeEquipmentCost.lua

```
RN.loanYears                    = 7;
RN.salaryPerHour                = 16.50;
RN.equipmentTax                 = 0.01;
RN.equipmentInsurance           = 0.005;
RN.equipmentHousing             = 0.005;
RN.equipmentRepairFactor        = 0.01;
RN.fuelPerHourPerHP             = 0.1667;
RN.lubricationFractionOfFuel    = 0.15;
RN.fuelCostPerLiter             = RN.commodityDensity.FUEL *
                                  RN.commodityPricePer100kg.FUEL/100;
RN.tractorFieldHoursPerYear     = 400;
```

Table 43. Cost parameters for tractor.

```
RN.equipment.price["TRACTOR100HP"]                = 65000; -- €
RN.equipment.loanTime["TRACTOR100HP"]             = RN.loanYears; -- years
RN.equipment.lifeTime["TRACTOR100HP"]             = 15; -- years
RN.equipment.depreciationRate["TRACTOR100HP"]     = 0.1; -- 10%
RN.equipment.neededHP["TRACTOR100HP"]             = 100; -- hp
RN.equipment.fuelPerHourPerHP["TRACTOR100HP"]     = RN.fuelPerHourPerHP;
RN.equipment.fieldHours["TRACTOR100HP"]           = RN.tractorFieldHoursPerYear;
RN.contractRatePerHour["TRACTOR100HP"] =    RN.contractRatePerHour["TRACTOR200HP"]
                                  + (RN.equipment.neededHP["TRACTOR100HP"] - 200)
```

Loan interest is set in RealNumbersInitialization.lua together with inflation rate. The net interest rate on loans is the loan interest (default 4%) minus the inflation rate (default 2%). The loan period is set to 7 years. The calculations following here are adapted from work presented by William Edwards, Extension economist at Iowa State University[3].

The variable cost of tractors includes repairs, fuel, lubrication and labor. The total cost of repair over 15 years is set to 1% of the purchase price. Fuels consumption is et to 0.1667 L per hour per hp. For a 100 hp tractor this would be 16.67 L/hour. Multiplying by the cost of fuel per liter we get the fuel cost per hour. The lubrication cost is set at 15% of fuel cost. Labor cost is set to 16.5 € per hour.

Example calculations for 5 tractors are shown in Table 48. Fixed costs include financing, depreciation, tax, insurance, and housing. Variable (operating) costs includes fuel, lubrication, labor, and repairs. For a 100 HP tractor, the operating cost per hour is about 39 € and the fixed cost about 19 €/hour for 400 hours per year. The total cost is then 50 €/hour. Renting a contractor to provide a

[3] William Edwards, Estimating Farm Machinery Cost, A3-29.
https://www.extension.iastate.edu/agdm/crops/html/a3-29.html

driver and a 100 HP tractor will cost about 66 €/hour. So, for this size tractor, used for 400 hours per year, it pays off to own the tractor.

For the 200 HP tractor it is cheaper to hire a contractor. You will need to use the purchased tractor for 630 hours per year to reach break-even. For the 500 HP tractor, break-even hours per year is 1024.

Table 44. Cost of tractor ownership.

		TRACTOR100HP	TRACTOR200HP	TRACTOR300HP	TRACTOR400HP	TRACTOR500H
Price	€	65000	199000	265000	315000	382000
Loan time	years	7	7	7	7	7
Life time	years	15	15	15	15	15
Net interest rate	%	2.0000	2.0000	2.0000	2.0000	2.0000
Interest cost	€	9665	29588	39402	46836	56798
Loan cost	€	74665	228588	304402	361836	438798
Depreciation rate per year	-	0.1000	0.1000	0.1000	0.1000	0.1000
Salvage fraction	-	0.2059	0.2059	0.2059	0.2059	0.2059
Sell price	€	13383	40972	54561	64856	78650
Loan payment	€	61282	187616	249841	296980	360148
Life time depreciation	€	51617	158028	210439	250144	303350
Investment cost	€	112899	345644	460279	547125	663497
Investment cost per year	€/year	7527	23043	30685	36475	44233
Tax, insurance, housing cost	€/year	52	160	213	253	307
Fixed cost per year	€/year	7579	23203	30898	36728	44540
Tractor hours per year	hours/year	400.0000	400.0000	400.0000	400.0000	400.0000
Tractor hours life time	hours	6000	6000	6000	6000	6000
Repair factor	-	0.0100	0.0100	0.0100	0.0100	0.0100
Repairs per year	€/year	43	133	177	210	255
Repairs per hour	€/hour	0.1083	0.3317	0.4417	0.5250	0.6367
Tractor HP	hp	100	205	300	400	517
Fuel per hour	L/hour	16.6700	34.1735	50.0100	66.6800	86.1839
Fuel cost per hour	€/hour	12.8588	26.3606	38.5765	51.4353	66.4801
Lubrication cost per hour	€/hour	1.9288	3.9541	5.7865	7.7153	9.9720
Labor cost per hour	€/hour	16.5000	16.5000	16.5000	16.5000	16.5000
Operating cost per hour	€/hour	31.3960	47.1463	61.3046	76.1756	93.5888
Ownership cost per hour	€/hour	18.9471	58.0073	77.2458	91.8205	111.3506
Tractor cost per hour	€/hour	50	105	139	168	205
Tractor cost per year	€/year	20137	42061	55420	67198	81976
Contract cost per hour	€/hour	66	84	101	117	137
Contract cost per year	€/year	26532	33533	40201	46869	54671
Break-even field hours	hours/year	218	630	784	890	1024

The user of the mod can of course change the data to fit specific tractors on their farm. For tractors, the primary parameters to adjust are the purchase price and the horsepower. The key parameter to monitor is the break-even hours. If this is higher than your expected use of the tractor measured in hours per year, then the tractor is too expensive for your farming operation.

The break-even hours are measured against typical contracting prices in Denmark. The user will have to adjust the contracting rates to local values, if they differ significantly from the rates used as default. The contract rates for tractors are scaled to horse powers based on a known contract rate for a 200 hp tractor (84 € per hour plus/minus 0.1667 € per hp).

12.2 Implements

The fixed and variable costs of implements are calculated in ways like that for tractors, except, costs are per hectare rather than per hours. The variable cost, here called Operating cost, includes cost of fuel. Fuel is here calculated on the estimated horsepower needed to pull the implement, not on the engine horsepower of the tractor. The rational of this is that a 500 hp tractor will use much less fuel pulling a windrower than pulling a 12 m wide cultivator.

Table 45. Input parameters for estimating equipment ownership cost. More equipment included in the script.

```
RN.equipment.price["MANURESPREADER"]                      = 27500; --  €
RN.equipment.loanTime["MANURESPREADER"]                   = RN.loanYears;     -- years
RN.equipment.lifeTime["MANURESPREADER"]                   = 20;     -- years
RN.equipment.depreciationRate["MANURESPREADER"]           = 0.1;
RN.equipment.width["MANURESPREADER"]                      = 9;    -- m
RN.equipment.speed["MANURESPREADER"]                      = 8;    -- kph
RN.equipment.efficiency["MANURESPREADER"]                 = 0.63;
RN.equipment.workArea["MANURESPREADER"]                   =
                                                    RN.fieldArea["MANURESPREADER"];
RN.equipment.neededHP["MANURESPREADER"]                   = 110; -- hp
RN.equipment.fuelPerHourPerHP["MANURESPREADER"]           = RN.fuelPerHourPerHP;
```

```
RN.equipment.price["SEEDERS"]                             = 13000; --  €
RN.equipment.loanTime["SEEDERS"]                          = RN.loanYears;     -- years
RN.equipment.lifeTime["SEEDERS"]                          = 20;     -- years
RN.equipment.depreciationRate["SEEDERS"]                  = 0.1;
RN.equipment.width["SEEDERS"]                             = 3;    -- m
RN.equipment.speed["SEEDERS"]                             = 10;  -- kph
RN.equipment.efficiency["SEEDERS"]                        = 0.70;
RN.equipment.workArea["SEEDERS"]                          = RN.fieldArea["SEEDERS"];
RN.equipment.neededHP["SEEDERS"]                          = 85;  -- hp
RN.equipment.fuelPerHourPerHP["SEEDERS"]                  = RN.fuelPerHourPerHP;
```

```
RN.equipment.price["HARVESTERS"]                          = 156000; --  €
RN.equipment.loanTime["HARVESTERS"]                       = RN.loanYears;     -- years
RN.equipment.lifeTime["HARVESTERS"]                       = 15;     -- years
RN.equipment.depreciationRate["HARVESTERS"]               = 0.1;
RN.equipment.width["HARVESTERS"]                          = 5;    -- m
RN.equipment.speed["HARVESTERS"]                          = 7;    -- kph
RN.equipment.efficiency["HARVESTERS"]                     = 0.82;
RN.equipment.workArea["HARVESTERS"]                       =
                                                           RN.fieldArea["HARVESTERS"];
RN.equipment.neededHP["HARVESTERS"]                       = 180; -- hp
RN.equipment.fuelPerHourPerHP["HARVESTERS"]               = RN.fuelPerHourPerHP;
```

The script uses a set of input parameters for each implement (Table 45). Key parameters are the purchase price, the implement width, the work speed, and field efficiency. The latter three parameters are used to calculate the field capacity of the implement.

$$Field\ capacity\ \left(\frac{ha}{hour}\right) = \frac{width\ (m)\ \times\ speed\ (kph)\ \times\ efficiency}{10}$$

Using the equation on the small harvester in Table 45, we get:

$$Field\ capacity = \frac{5\ m \times 7\ kph \times 0.82}{10} = 2.87\ ha/hour$$

Field efficiency is always less than 100%. Some time is wasted on turns at the head lands, some is used for emptying or refilling implement, and some is wasted because the full width of the equipment is not used due to overlap between runs. Implements with frequent refills, such as a manure spreader, will have a low efficiency even if the width is large.

How wide should the implements be?

A mod user (and farmer) informed me that they were using a concept called hectare-feet for judging implement size. It refers to the ratio of arable land to implement width. The top three lines Table 46 was given by the farmer. Lines 4 - 6 translates the same numbers to metrics. Lines 7 and 8 list the typical work speed and field efficiency of the implement, line 9 lists the effective field capacity per meter width, and line 10 lists the effective hectare-to-meter ratio. Lines 11 - 13 lists the time required to cover the land with an implement of 1 m in width. If you double the width, you divide the time by two.

Table 46. Typical field capacity of implements in Alberta and UK.

		Alberta	UK
1	Acre	1300	700
2	ft	31	13
3	Ac/ft	41,9	53,8
4	Hectares	526,5	283,5
5	Meters	9,455	3,965
6	Ha/m	55,7	71,5
7	Velocity (kph)	10	10
8	Efficiency	0,6	0,6
9	Ha/(hour m) eff	0,6	0,6
10	Ha/m eff	92,8	119,2
11	Hours/m	154,7	198,6
12	Work day	8	8
13	Days/m	19,3	24,8

The field capacity varies with work speed and efficiency and is therefore different for different types of implements. Field capacity for a 1 m wide implement is calculated in Table 47 for a range of work speed and work efficiency. For a 6 m wide implement, multiply the table values by 6.

Table 47. Hectares worked per hour when implement width is 1 m.

		Efficiency						
kpm	kph	0,55	0,6	0,65	0,7	0,75	0,8	0,85
3,1	5	0,275	0,3	0,325	0,35	0,375	0,4	0,425
3,8	6	0,33	0,36	0,39	0,42	0,45	0,48	0,51
4,4	7	0,385	0,42	0,455	0,49	0,525	0,56	0,595
5,0	8	0,44	0,48	0,52	0,56	0,6	0,64	0,68
5,6	9	0,495	0,54	0,585	0,63	0,675	0,72	0,765
6,3	10	0,55	0,6	0,65	0,7	0,75	0,8	0,85
6,9	11	0,605	0,66	0,715	0,77	0,825	0,88	0,935
7,5	12	0,66	0,72	0,78	0,84	0,9	0,96	1,02
8,1	13	0,715	0,78	0,845	0,91	0,975	1,04	1,105
8,8	14	0,77	0,84	0,91	0,98	1,05	1,12	1,19
9,4	15	0,825	0,9	0,975	1,05	1,125	1,2	1,275
10,0	16	0,88	0,96	1,04	1,12	1,2	1,28	1,36
10,6	17	0,935	1,02	1,105	1,19	1,275	1,36	1,445
11,3	18	0,99	1,08	1,17	1,26	1,35	1,44	1,53
11,9	19	1,045	1,14	1,235	1,33	1,425	1,52	1,615
12,5	20	1,1	1,2	1,3	1,4	1,5	1,6	1,7

Planter	Manure	Fert	Disk	Plow
Spray	Seeder	Comb	Mower	Chisel
			Rake	Tine

Table 48. Field work hours per 10 ha, when implement width is 1 m.

Hectares	10	Efficiency						
kpm	kph	0,55	0,6	0,65	0,7	0,75	0,8	0,85
3,1	5	36,4	33,3	30,8	28,6	26,7	25,0	23,5
3,8	6	30,3	27,8	25,6	23,8	22,2	20,8	19,6
4,4	7	26,0	23,8	22,0	20,4	19,0	17,9	16,8
5,0	8	22,7	20,8	19,2	17,9	16,7	15,6	14,7
5,6	9	20,2	18,5	17,1	15,9	14,8	13,9	13,1
6,3	10	18,2	16,7	15,4	14,3	13,3	12,5	11,8
6,9	11	16,5	15,2	14,0	13,0	12,1	11,4	10,7
7,5	12	15,2	13,9	12,8	11,9	11,1	10,4	9,8
8,1	13	14,0	12,8	11,8	11,0	10,3	9,6	9,0
8,8	14	13,0	11,9	11,0	10,2	9,5	8,9	8,4
9,4	15	12,1	11,1	10,3	9,5	8,9	8,3	7,8
10,0	16	11,4	10,4	9,6	8,9	8,3	7,8	7,4
10,6	17	10,7	9,8	9,0	8,4	7,8	7,4	6,9
11,3	18	10,1	9,3	8,5	7,9	7,4	6,9	6,5
11,9	19	9,6	8,8	8,1	7,5	7,0	6,6	6,2
12,5	20	9,1	8,3	7,7	7,1	6,7	6,3	5,9

Planter	Manure	Fert	Disk	Plow
Spray	Seeder	Comb	Mower	Chisel
			Rake	Tine

Let us use the data in Table 48 for a few examples. Let us say we need to use a planter on 100 hectares and we have at most 40 hours to do so.

$$Field\ work\ hours = \frac{Field\ work\ hours \cdot 1\ m}{Implement\ width\ (m)} \cdot \frac{Worked\ hectares}{10\ Ha}$$

We can reorganize this to solve for the implement width:

$$Implement\ width\ (m) = \frac{Field\ work\ hours \cdot 1\ m}{Field\ work\ hours} \cdot \frac{Worked\ hectares}{10\ Ha}$$

Using the numbers in the example, we get:

$$Implement\ width\ (m) = \frac{17.1\ hours\ \cdot 1\ m}{40\ hours} \cdot \frac{100\ Ha}{10\ Ha} = 4.28\ m$$

Here we have looked up the value of 17.1 for a planter assuming a velocity of 9 kph and an efficiency of 0.65.

Let us also assume that we need to disc harrow the 100 hectares and that we have 20 hours to do so.

$$Implement\ width\ (m) = \frac{13.9\ hours\ \cdot 1\ m}{20\ hours} \cdot \frac{100\ Ha}{10\ Ha} = 6.95\ m$$

If our tractor can only pull a 6 m wide disc harrow, the time needed to work the 100 hectares is:

$$Field\ work\ hours = \frac{13.9 \cdot 1\ m}{6\ (m)} \cdot \frac{100\ Ha}{10\ Ha} = 23.2\ hours$$

The script **RealNumbersEquipmentEconomy** attempts to provide an economic overview of some typical implements in Farming Simulator. The width used in the script are those found on implements in FS19. The working speed is typical real-life working speed, not the max speed in FS19. A reduced purchase price is used if the user indicates the use of the mod Buy Used Equipment by w33zl.

Table 49. Break-even analysis of owning and using implements.

		MANURESPREADER	SLURRYTANKS	PLOWS	DISCHARROWS	CULTIVATOR
Price	€	27500	23000	14000	18000	7000
Loan duration	years	7	7	7	7	7
Life time	years	20	20	20	20	20
Net interest rate	%	2.0000	2.0000	2.0000	2.0000	2.0000
Interest cost	€	4089	3420	2082	2676	1041
Loan cost	€	31589	26420	16082	20676	8041
Depreciation rate per year	-	0.1000	0.1000	0.1000	0.1000	0.1000
Salvage fraction	-	0.1216	0.1216	0.1216	0.1216	0.1216
Sell price	€	3343	2796	1702	2188	851
Loan payment	€	28245	23624	14380	18488	7190
Life time depreciation	€	24157	20204	12298	15812	6149
Investment cost	€	52402	43827	26677	34300	13339
Investment cost per year	€/year	2620	2191	1334	1715	667
Tax, insurance, housing cost	€/year	15	13	8	10	4
Fixed cost per year	€/year	2636	2204	1342	1725	671
Implement width	m	9.0000	9.0000	2.5000	3.0000	3.0000
Implement speed	kph	8.0000	8.0000	12.0000	10.0000	15.0000
Implement efficiency	-	0.6300	0.6000	0.8500	0.8300	0.8500
Implement capacity	ha/hour	4.5360	4.3200	2.5500	2.4900	3.8250
Implement work area	ha/year	80.1000	25.0000	80.1000	25.0000	84.9000
Implement hours per year	hours/year	17.6587	5.7870	31.4118	10.0402	22.1961
Implement hours life time	hours	353	116	628	201	444
Repair factor	-	0.0100	0.0100	0.0100	0.0100	0.0100
Repairs per year	€/year	14	12	7	9	4
Repairs per hour	€/hour	0.7787	1.9872	0.2228	0.8964	0.1577
Required HP	hp	110	85	150	100	100
Fuel per hour	L/hour	18.3370	14.1695	25.0050	16.6700	16.6700
Fuel cost per hour	€/hour	14.1447	10.9300	19.2882	12.8588	12.8588
Lubrication cost per hour	€/hour	2.1217	1.6395	2.8932	1.9288	1.9288
Labor cost per hour	€/hour	16.5000	16.5000	16.5000	16.5000	16.5000
Operating cost per hour	€/hour	33.5451	31.0567	38.9043	32.1840	31.4453
Operating cost per ha	€/ha	7.3953	7.1891	15.2566	12.9253	8.2210
Fixed cost per ha	€/ha	32.9030	88.1704	16.7506	69.0029	7.9018
Fixed + op. cost per ha	€/ha	40	95	32	82	16
Fixed + op. cost per hour	€/hour	183	412	82	204	62
Fixed + op. cost per year	€/year	3228	2384	2564	2048	1369
Contract cost per ha	€/ha	130	130	112	35	35
Contract cost per hour	€/hour	590	562	286	87	134
Contract cost per year	€/year	10413	3250	8971	875	2972
Break-even fixed cost per ha	€/ha	123	123	97	22	27
Break-even ha	ha/year	21	18	14	78	25
Break-even field hours	hours/year	5	4	5	31	7

The operating cost includes fuel, lubrication and labor. To calculate these costs, we need to know the number of hours of use per year of the implement. We therefore need to enter the estimated total work area per year for the equipment. For the manure spreader in Table 49, the total work area is set to 75 ha/year. With a field capacity of 4.54 ha/hour, we get 16.5 hours per year. Using the hourly cost of repair, fuel, lubrication and labor, we can calculate the operating cost per hour and per hectare. Dividing the annual fixed cost with the total work are, we also get the fixed cost per hectare. The sum of fixed cost and operating cost gives us the expense per hectare of owning and using the implement. We can compare this cost to the cost of hiring a contractor.

For the manure spreader the total cost of ownership and use adds up to 45 € per ha. The cost of hiring a contractor is 130 € per ha. The break-even hectare is 22 ha, meaning if our work area per year is higher than 22 ha, we will save money by owning this manure spreader. This is a very small manure spreader with an implement width of only 9 m. If we decided to get a more expensive manure spreader, the break-even hectare would increase. For the slurry spreader, the break-even hectare is 18 ha, but we only need it for 8 ha. So, it would be better to hire a contractor to spread slurry.

If we look at the disc harrow and the tine cultivator, we see that contractor rates are very competitive. We would need to disc harrow 95 ha with a 3 m wide disc harrow to beat the contractor rate. For the tine cultivator we need to cultivate 28 ha with a 3 m wide cultivator to beat the contractor.

The break-even hectare is very high even for very small implements. In my own FS games, I hardly ever have more than 50 ha, hence the economic analysis indicates that a number of field jobs should be contracted, in particular harvesting jobs.

The economy of baling involves a different approach. It is described in the next subsection.

12.3 Bailing equipment

Contract rates for baling are often given as a fee per bale and differs for hay and silage, and for round bales and square bales. This is addressed in the script RealNumbersBalingEquipmentEconomy.lua.

Table 50. Typical contract baling fees in Denmark. €/bale.

```
RN.contractRatePerBale.SILAGEROUNDBALE          = 19;    -- contract fee per bale
RN.contractRatePerBale.SILAGESQUAREBALE         = 22;    -- contract fee per bale
RN.contractRatePerBale.DRYGRASSROUNDBALE        =  9;    -- contract fee per bale
RN.contractRatePerBale.DRYGRASSSQUAREBALE       = 11;    -- contract fee per bale
RN.contractRatePerBale.STRAWROUNDBALE           =  7;    -- contract fee per bale
RN.contractRatePerBale.STRAWSQUAREBALE          =  8;    -- contract fee per bale
```

The work capacity of a baler is determined by its throughput (tonnes) per hour. By default, all balers are set to have a throughput of 16 tonnes per hour (Table 51).

Table 51. Throughput performance of balers in Tonnes/hour.

```
RN.throughPutTonPerHour.SILAGEROUNDBALE     = 16; --Ton/hour
RN.throughPutTonPerHour.SILAGESQUAREBALE    = 16; --Ton/hour
RN.throughPutTonPerHour.DRYGRASSROUNDBALE   = 16; --Ton/hour
RN.throughPutTonPerHour.DRYGRASSSQUAREBALE  = 16; --Ton/hour
RN.throughPutTonPerHour.STRAWROUNDBALE      = 16; --Ton/hour
RN.throughPutTonPerHour.STRAWSQUAREBALE     = 16; --Ton/hour
```

The input parameters for calculating baling costs are shown in Table 52. The total cost of baling with own equipment includes the fixed cost of owning the equipment, the operating cost of the equipment itself (repair, field, lubrication, labor) and the cost of supplies (wrapping cost, plastic cost). See Table 53.

We notice that the baler field capacity varies depending on if we bale silage, hay or straw. This is because the mass of the baling material varies while the throughput capacity is the same. Since the same baler is used for making silage, hay and straw bales, the fixed cost per bale is influenced by how many bales are made of each type. Hence, the cost of silage baling in Table 57 is influenced by the hectares baled of hay and straw and vice versa. The break-even hectare for square balers is a little more than two times that for round balers.

Table 52. Input parameters for analysis of baling economy. More bale types are included in the script.

```
RN.equipment.loanTime["SILAGEROUNDBALE"]         = RN.loanYears; -- years
RN.equipment.lifeTime["SILAGEROUNDBALE"]         = 20; -- years
RN.equipment.depreciationRate["SILAGEROUNDBALE"] = 0.1;
RN.equipment.efficiency["SILAGEROUNDBALE"]       = 0.80;
RN.equipment.workArea["SILAGEROUNDBALE"]     = RN.fieldArea["SILAGEROUNDBALE"];
RN.equipment.neededHP["SILAGEROUNDBALE"]         = 110; -- hp
RN.equipment.fuelPerHourPerHP["SILAGEROUNDBALE"] = RN.fuelPerHourPerHP;
RN.equipment.wrappingPerBale["SILAGEROUNDBALE"]  = 7.5; -- €/bale
RN.equipment.plasticPerBale["SILAGEROUNDBALE"]   = 3; -- €/bale
```

```
RN.equipment.price["STRAWSQUAREBALE"]            = 105000; -- €
RN.equipment.loanTime["STRAWSQUAREBALE"]         = RN.loanYears; -- years
RN.equipment.lifeTime["STRAWSQUAREBALE"]         = 20; -- years
RN.equipment.depreciationRate["STRAWSQUAREBALE"] = 0.1;
RN.equipment.efficiency["STRAWSQUAREBALE"]       = 0.80;
RN.equipment.workArea["STRAWSQUAREBALE"]     = RN.fieldArea["STRAWSQUAREBALE"];
RN.equipment.neededHP["STRAWSQUAREBALE"]         = 140; -- hp
RN.equipment.fuelPerHourPerHP["STRAWSQUAREBALE"] = RN.fuelPerHourPerHP;
RN.equipment.wrappingPerBale["STRAWSQUAREBALE"]  = 0;
RN.equipment.plasticPerBale["STRAWSQUAREBALE"]   = 0;
```

Table 53. Cost of baling with own equipment.

			SILAGE BALING		DRYGRASS BALING		STRAW BALING	
			Round	Square	Round	Square	Round	Square
Price	: €	:	76000	105000	76000	105000	76000	105000
Loan time	: years	:	7	7	7	7	7	7
Life time	: years	:	20	20	20	20	20	20
Net interest rate	: %	:	2.0000	2.0000	2.0000	2.0000	2.0000	2.0000
Interest cost	: €	:	11300	15612	11300	15612	11300	15612
Loan cost	: €	:	87300	120612	87300	120612	87300	120612
Depreciation rate per year	: -	:	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
Salvage fraction	: -	:	0.1216	0.1216	0.1216	0.1216	0.1216	0.1216
Sell price	: €	:	9240	12766	9240	12766	9240	12766
Loan payment	: €	:	78060	107846	78060	107846	78060	107846
Life time depreciation	: €	:	66760	92234	66760	92234	66760	92234
Investment cost	: €	:	144820	200081	144820	200081	144820	200081
Investment cost per year	: €/year	:	7241	10004	7241	10004	7241	10004
Tax, insurance, housing cost	: €/year	:	43	59	43	59	43	59
Fixed cost per year	: €/year	:	7284	10063	7284	10063	7284	10063
Partial fixed cost per year	: €/year	:	1420	1962	2841	3925	3023	4176
Throughput	: Ton/hour	:	16.0000	16.0000	16.0000	16.0000	16.0000	16.0000
Ton per ha	: Ton/ha	:	21.5190	21.5190	9.2795	9.2795	3.6760	3.6760
Implement efficiency	: -	:	0.8000	0.8000	0.8000	0.8000	0.8000	0.8000
Implement capacity	: ha/hour	:	0.5948	0.5948	1.3794	1.3794	3.4820	3.4820
Implement work area	: ha/year	:	7.8000	7.8000	15.6000	15.6000	16.6000	16.6000
Implement hours per year	: hours/year	:	13.1131	13.1131	11.3094	11.3094	4.7673	4.7673
Implement hours life time	: hours	:	262	262	226	226	95	95
Repair factor	: -	:	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100
Repairs per year	: €/year	:	38	53	38	53	38	53
Repairs per hour	: €/hour	:	2.8979	4.0036	3.3600	4.6422	7.9709	11.0125
Required HP	: hp	:	110	140	110	140	110	140
Fuel per hour	: L/hour	:	18.3370	23.3380	18.3370	23.3380	18.3370	23.3380
Fuel cost per hour	: €/hour	:	14.1447	18.0023	14.1447	18.0023	14.1447	18.0023
Lubrication cost per hour	: €/hour	:	2.1217	2.7004	2.1217	2.7004	2.1217	2.7004
Labor cost per hour	: €/hour	:	16.5000	16.5000	16.5000	16.5000	16.5000	16.5000
Operating cost per hour	: €/hour	:	35.6643	41.2063	36.1265	41.8449	40.7374	48.2152
Operating cost per year	: €/year	:	467.6703	540.3440	408.5672	473.2388	194.2077	229.8569
Operating cost per ha	: €/ha	:	59.9577	69.2749	26.1902	30.3358	11.6993	13.8468
Operating cost per bale	: €/bale	:	1.7043	3.4229	0.8411	1.6934	0.6489	1.3350
Fixed cost per ha	: €/ha	:	182.0911	251.5732	182.0911	251.5732	182.0911	251.5732
Fixed cost per bale	: €/bale	:	5.1760	12.4303	5.8477	14.0433	10.0999	24.2554
Fixed + op. cost per ha	: €/ha	:	242	321	208	282	194	265
Fixed + op. cost per year	: €/year	:	1888	2503	3249	4398	3217	4406
Fixed + op. cost per bale	: €/bale	:	7	16	7	16	11	26
Supply cost per bale	: €/bale	:	11	11	0	0	0	0
Supply cost per ha	: €/ha	:	369	213	0	0	0	0
Operating and supply cost per ha	: €/ha	:	429	282	26	30	12	14
Fixed + op. + supply cost per ha	: €/ha	:	611	533	208	282	194	265
Contract cost per bale	: €/bale	:	19	22	9	11	7	8
Contract cost per ha	: €/ha	:	668	445	280	197	126	83
Contract cost per year	: €/year	:	5214	3473	4372	3074	2095	1377
Break-even fixed cost per ha	: €/ha	:	239	163	254	167	115	69
Break-even ha	: ha/year	:	6	12	11	24	26	60

13 Cost of crop production

A new script has been added in version 1.2.3.8 to make estimates of cost of production for crops. It is called **RealNumbersCropProductionCost.lua**. Costs of crop production include supply costs (seed, fertilizer and herbicides), cost of field work and the money value of field rent. The latter is included because any income from crop operation must exceed the income you could have received by renting out the field.

The cost of field work depends on what kind of field work you plan to do and what kind of crop you grow. In the script **RealNumbersCropProductionCost.lua** is defined what types of field work is to be done for all crop types. Some common input parameters are set in RealNumbersInitialization.lua

Table 54. Input parameters for field work.

```
RN.myFieldCrops["BARLEY"]                                  = {};
RN.myFieldCrops["BARLEY"]["fields"]                        = {};
RN.myFieldCrops["BARLEY"]["myFieldArea"]                   = {};
RN.myFieldCrops["BARLEY"]["totalArea"]                     = 0;     -- ha,
RN.myFieldCrops["BARLEY"]["fruitName"]                     = "BARLEY";
RN.myFieldCrops["BARLEY"]["fields"]                         = {32};
RN.myFieldCrops["BARLEY"]["myFieldArea"]                    = {7.7};
RN.myFieldCrops["BARLEY"]["manure"]           = RN.manureApplications["BARLEY"];
RN.myFieldCrops["BARLEY"]["slurry"]           = RN.slurryApplications["BARLEY"];
RN.myFieldCrops["BARLEY"]["lime"]             = RN.limeApplications["BARLEY"];
RN.myFieldCrops["BARLEY"]["plow"]                           = 1 * RN.isPlowing["BARLEY"];
RN.myFieldCrops["BARLEY"]["subsoil"]          = 0 * RN.isPlowing["BARLEY"];
RN.myFieldCrops["BARLEY"]["tineharrow"]   = 1 * (1- RN.isDirectSeeding["BARLEY"]);
RN.myFieldCrops["BARLEY"]["discharrow"]   = 0 * (1- RN.isDirectSeeding["BARLEY"]);
RN.myFieldCrops["BARLEY"]["powerharrow"] = 0 * (1- RN.isDirectSeeding["BARLEY"]);
RN.myFieldCrops["BARLEY"]["seed"]                           = 1;
RN.myFieldCrops["BARLEY"]["plant"]                          = 0;
RN.myFieldCrops["BARLEY"]["potatoplant"]                    = 0;
RN.myFieldCrops["BARLEY"]["solidfertilizer"]                = RN.solidFertApplications["BARLEY"];
RN.myFieldCrops["BARLEY"]["liquidfertilizer"]               = RN.liquidFertApplications["BARLEY"];
RN.myFieldCrops["BARLEY"]["spraychemicals"]  = RN.herbicideApplications["BARLEY"];
RN.myFieldCrops["BARLEY"]["rolling"]  = 1 * (1- RN.isDirectSeeding["BARLEY"]);
RN.myFieldCrops["BARLEY"]["mechanicalweeding"] = 0;
RN.myFieldCrops["BARLEY"]["cerealharvest"]                  = 1;
RN.myFieldCrops["BARLEY"]["rowharvest"]                     = 0;
RN.myFieldCrops["BARLEY"]["beetharvest"]                    = 0;
RN.myFieldCrops["BARLEY"]["potatoharvest"]                  = 0;
RN.myFieldCrops["BARLEY"]["forageharvest"]                  = 0;
RN.myFieldCrops["BARLEY"]["mowing"]                         = 0;
RN.myFieldCrops["BARLEY"]["windrow"]                        = 0;
RN.myFieldCrops["BARLEY"]["tedding"]                        = 0;
RN.myFieldCrops["BARLEY"]["bale"]                           = 1;
RN.myFieldCrops["BARLEY"]["balewrap"]                       = 0;
RN.myFieldCrops["BARLEY"]["balecollect"]                    = 1;
```

We see that 7.7 ha of barley is grown in field 32. No windrowing is done, but costs of baling and bale carting is included. For a silage forage crop, plastic bale wrapping would be added to the cost.

The total cost of field work is itemized in Table 55.

Table 55. Itemized cost of field work.

€/Ha		Nat Fert Lime	Plow costs	Cultivate Seed	Fert costs	Herb costs	Harvest costs	Field work Total
ALFALFA	: €/Ha	86	32	62	38	19	912	1148
BARLEY	: €/Ha	86	32	62	38	19	165	401
CABBAGE	: €/Ha	86	32	94	38	19	290	558
CANOLA	: €/Ha	86	32	62	38	19	165	401
CARROT	: €/Ha	86	32	94	38	19	290	558
CLOVER	: €/Ha	86	32	62	38	19	912	1148
COFFEE	: €/Ha	46	0	62	56	19	165	348
COTTON	: €/Ha	86	32	94	38	19	0	268
DRYALFALFA	: €/Ha	86	32	62	38	19	566	802
DRYCLOVER	: €/Ha	86	32	62	38	19	566	802
DRYGRASS	: €/Ha	86	32	62	38	19	566	802
GRASS	: €/Ha	86	32	62	38	19	912	1148
HEMP	: €/Ha	46	0	94	56	19	165	380
HOPS	: €/Ha	46	0	62	56	19	165	348
LETTUCE	: €/Ha	86	32	94	38	19	290	558
MAIZE	: €/Ha	86	32	94	38	19	165	433
MILLET	: €/Ha	86	32	62	38	19	165	401
MUSTARD	: €/Ha	86	32	62	38	19	165	401
OAT	: €/Ha	86	32	62	38	19	165	401
OILSEEDRADISH	: €/Ha	46	32	62	0	19	0	158
ONION	: €/Ha	86	32	94	38	19	290	558
POPLAR	: €/Ha	0	0	16	56	0	0	72
POPPY	: €/Ha	86	32	62	38	19	165	401
POTATO	: €/Ha	86	32	884	38	19	660	1719
REDCABBAGE	: €/Ha	86	32	94	38	19	290	558
RICE	: €/Ha	86	32	62	38	19	165	401
RYE	: €/Ha	86	32	62	38	19	165	401
SOYBEAN	: €/Ha	86	32	62	38	19	165	401
SUGARBEET	: €/Ha	86	32	94	38	19	290	558
SUGARCANE	: €/Ha	86	32	16	38	19	0	191
SUNFLOWER	: €/Ha	86	32	94	38	19	165	433
TOBACCO	: €/Ha	46	0	62	56	19	165	348
WHEAT	: €/Ha	86	32	62	38	19	165	401

In some cases, a zero appears because the value is unknown to me. For seeding, fertilizing and herbicide applications, the expenses are purely related to the equipment involved, not the supply itself. The equipment cost is based on the data entered into Table 49 concerning size and price of equipment and the crop area required to feed the farm animals (later chapter).

When the cost of field work is known, we can calculate the cost of production of each crop type (see Table 56). Gross income is the money we would get from selling the crop. The net income is the money left when supply costs have been paid. It is the net income that has to cover the cost of field work. Subtracting field work and field rent from net income we get what is left (the profit). For many crops the profit is negative. This indicates that the crop is not a good crop if you plan to sell the harvested crop. This is the case for forage and grain crops. The crops suitable for selling are specialty crops such as vegetable crops, hemp, hops, and tobacco. The grain and forage crops are only of value as animal feed.

Table 56. Cost of crop production.

€/Ha		Gross income	Supply costs	Net income	Field work	Field rent	Profit	Feed cost €/L
ALFALFA	: €/Ha	970	523	447	1148	381	-1081	0.043
BARLEY	: €/Ha	687	307	381	401	381	-401	0.118
CABBAGE	: €/Ha	24665	929	23735	558	381	22796	0.015
CANOLA	: €/Ha	624	639	-15	401	381	-797	0.394
CARROT	: €/Ha	21079	843	20236	558	381	19297	0.019
CLOVER	: €/Ha	1273	577	697	1148	381	-832	0.034
COFFEE	: €/Ha	23637	5694	17943	348	381	17215	2.712
COTTON	: €/Ha	2041	895	1146	268	381	497	0.211
DECOFOLIAGE	: €/Ha	1080	1048	32	0	381	-349	0.044
DRYALFALFA	: €/Ha	683	523	161	802	381	-1022	0.040
DRYCLOVER	: €/Ha	985	577	408	802	381	-774	0.029
DRYGRASS	: €/Ha	1073	413	660	802	381	-523	0.024
GRASS	: €/Ha	1370	413	958	1148	381	-571	0.028
HEMP	: €/Ha	4351	547	3804	380	381	3043	0.267
HOPS	: €/Ha	20906	1608	19298	348	381	18569	0.855
LETTUCE	: €/Ha	41448	559	40889	558	381	39950	0.010
MAIZE	: €/Ha	1623	511	1111	433	381	297	0.061
MILLET	: €/Ha	284	281	3	401	381	-779	0.233
MUSTARD	: €/Ha	617	474	143	401	381	-639	0.761
OAT	: €/Ha	503	244	259	401	381	-522	0.111
OILSEEDRADISH	: €/Ha	0	112	-112	158	381	-651	0.076
ONION	: €/Ha	18586	1210	17376	558	381	16437	0.022
POPLAR	: €/Ha	1128	520	608	72	381	155	0.021
POPPY	: €/Ha	6960	327	6633	401	381	5852	0.063
POTATO	: €/Ha	9195	1266	7929	1719	381	5830	0.058
REDCABBAGE	: €/Ha	24665	929	23735	558	381	22796	0.015
RICE	: €/Ha	1958	876	1082	401	381	300	0.084
RYE	: €/Ha	494	405	89	401	381	-693	0.295
SOYBEAN	: €/Ha	1251	331	920	401	381	139	0.162
SUGARBEET	: €/Ha	932	877	55	558	381	-884	0.028
SUGARCANE	: €/Ha	2536	864	1672	191	381	1101	0.009
SUNFLOWER	: €/Ha	712	267	445	433	381	-369	0.180
TOBACCO	: €/Ha	14596	1303	13292	348	381	12564	0.521
WHEAT	: €/Ha	775	473	303	401	381	-479	0.147

Feed cost is calculated as:

$$Feed\ cost\ per\ liter = \frac{Supply\ cost\ per\ ha + Field\ work\ per\ ha}{Crop\ yield\ per\ ha}$$

We see that if we have a choice between sugarbeet and carrot for animal feed, we should use sugarbeet, because carrot gives a very good profit as a selling crop.

The cost of field work for each crop is rather high since the cost of owning each implement depends on the total hectares on which the implement is used. It is therefore necessary to set up a complete farming operation, where the total number of hectares for all crops are known. To do this, we need to estimate how much feed is consumed by our animals and how much land is needed to grow this amount of feed.

14 Field economy

The script **RealNumbersFarmland** has been extended (version 1.2.3.9) with a per field economy overview. This output was inspired by the field statistics presented in Precision Farming, but the information given here is slightly more detailed.

Table 57. Field economy data. Field 2 with carrots.

```
---------------------------------------------------------------
Field                          =        2
Farmland                       =       40
Farmland Area                  =       4.3796 ha
Field Area                     =       3.2807 ha
Farmland price                 =   110252.5441  €
Fruit name                     =  CARROT
Owner status                   =   Owned

---------------------------------------------------------------

Supply costs

                                        N         P         K
Removed from soil (kg)         =      787       269       469
cowMANURE (kg)                 =       33       106       469
FERTILIZER (kg)                =      754       163         0

cowMANURE                      =       55.45 To       221.81  €
FERTILIZER                     =      125.68 To       811.97  €
Lime (1/3)                     =        5.36 To        91.09  €
Seed - carrot                  =        9.06 kg       616.27  €
Herbicide                      =       73.54 kg       754.56  €

Supply cost                                    =     2495.70  €

---------------------------------------------------------------

Field work costs

Plow cost                                      =      132.16  €
Cultivator cost                                =      218.54  €
Manure spreader cost                           =       61.90  €
Slurry sprayer cost                            =        0.00  €
Lime spreader cost (1/3)                       =       10.76  €
Mineral fertilizer spreader cost               =      159.68  €
Liquid fertilizer sprayer cost                 =        0.00  €
Herbicide sprayer cost                         =      104.77  €
Seed planter cost                              =      871.70  €
Sugarbeet harvester cost                       =      472.27  €

Total field work cost                          =     2031.78  €

---------------------------------------------------------------

Crop value
Yield                          =      158.61 To     79145.15  €
No windrow                     =        0.00  L         0.00  €
Total cost                                     =     4527.49  €
Field earnings                                 =    74617.66  €
Field rent value                               =     1371.98  €
```

```
--------------------------------------------------------------

Precision Farming Data

Soilsamples                 =          18          270.00  €
Lime                        =    16800.39  L       328.05  €
Mineral fertilizer          =      686.60  L       325.26  €
Liquid fertilizer           =        0.00  L         0.00  €
Manure                      =    48857.31  L       114.97  €
Slurry                      =        0.00  L         0.00  €
Seeds                       =       23.85  L        39.98  €
Diesel                      =       30.38  L        17.79  €
Vehicle cost                               =       537.77  €
Helper cost                                =        39.62  €
--------------------------------------------------------------
Yield                       =        0.00  L         0.00  €

Total cost                                 =      1673.43  €

Earnings                                   =     -1673.43  €
==============================================================
```

The data presented here is based on the field work specified, the fertilizer strategy as well as the equipment economy. Lime application is done every three years. Hence the annual cost is one third of the application cost. The bottom part of the table is data generated by Precision Farming. It is presented here for comparison. Notice that I have reduced the price of soil samples within the Precision Farming mod itself. However, no efforts have been made to make the data generated by RealLifeNumbers agree with those generated by Precision Farming.

One important difference is that Precision Farming calculates the price of seeds based on the price of the generic Seed fillType. The price of seed varies tremendously between crop types, hence the field economy predicted by Precision Farming will not be very precise.

The data defining nitrogen need within Precision Farming has been extended to additional fruit types and the numbers have been made to agree with those used in RealLifeNumbers. Such data are found in the file named PrecisionFarming.xml within the Precision Farming mod.

Table 58. Nitrogen requirement definitions in Precision Farming. A very small fragment of the data.

```
<fruitRequirement fruitTypeName="ASPARAGUS" ignoreOverfertilization="true">
  <soil soilTypeIndex="1" targetLevel="80" reduction="70" yieldPotential="0.8"/>
  <soil soilTypeIndex="2" targetLevel="100" reduction="90" yieldPotential="1.0"/>
  <soil soilTypeIndex="3" targetLevel="120" reduction="100" yieldPotential="1.25"/>
  <soil soilTypeIndex="4" targetLevel="120" reduction="100" yieldPotential="0.9"/>
</fruitRequirement>
<fruitRequirement fruitTypeName="BEAN" ignoreOverfertilization="true">
  <soil soilTypeIndex="1" targetLevel="80" reduction="70" yieldPotential="0.8"/>
  <soil soilTypeIndex="2" targetLevel="100" reduction="90" yieldPotential="1.0"/>
  <soil soilTypeIndex="3" targetLevel="120" reduction="100" yieldPotential="1.25"/>
  <soil soilTypeIndex="4" targetLevel="120" reduction="100" yieldPotential="0.9"/>
</fruitRequirement>
```

Be aware, that some maps, like Chellington Valley, also has the same data, or a modified version thereof. In this case the map data will take precedence and modifying the data in Precision Farming will have no effect. I have modified this data in both places. **Modifying mods will cause problems when playing multiplayer games.**

15 Animal products

Sell prices for animal products (milk, wool and egg) have been obtained for EU countries and USDA agricultural regions. These prices are defined in the script **RealNumbersAnimalProducts**. Output to the log file is shown in Table 59. Random price variation is active.

Wool density is based on wool bales of 480 L and 180 kg yielding 0.375 kg/L. Egg density is based on 60 gram per egg and a package volume of 1.4 L per six eggs, yielding 0.257 kg/L.

Table 59. Sell prices for animal products (Example from US).

MILK massPerLiter	=	1.0250	kg/L
MILK pricePer1000Liter	=	467	€/1000 L
GOATMILK massPerLiter	=	1.0000	kg/L
GOATMILK pricePer1000Liter	=	801	€/1000 L
WOOL massPerLiter	=	0.3750	kg/L
WOOL pricePer1000Liter	=	599	€/1000 L
EGG massPerLiter	=	1.0370	kg/L
EGG pricePer1000Liter	=	1683	€/1000 L

Figure 20. Off to the spinnery. Felsbrunn.

16 Animal care

Seasons: A new script replaces the old AnimalCare script. It allows the user to adjust parameters for feed intake and waste output, but not the growth rate.

The present chapter provides typical data for growth and consumption of feed, water, straw, etc. Table 60 shows the typical number of animals on farms in different EU member states. Useful information if you want to set up an "average farm" in a specific country.

Table 60. Average number of animals on EU farms in 2015.

Country	Farms	Total animals	Dairy cows	Other cattle	Sheep and goats	Pigs	Poultry
(BEL) Belgium	29140,00	128,79	18,42	46,35	0,74	51,43	11,51
(BGR) Bulgaria	114420,00	11,79	2,64	2,60	2,55	2,00	1,92
(CYP) Cyprus	10470,00	8,55	1,81	0,86	3,62	0,58	1,68
(CZE) Czech Republic	17210,00	91,51	21,96	38,63	1,04	19,41	9,97
(DAN) Denmark	28330,00	144,96	20,83	21,38	0,51	95,28	6,42
(DEU) Germany	187460,00	89,55	23,19	26,12	0,68	36,17	2,71
(ELL) Greece	346580,00	6,01	0,13	1,06	4,48	0,08	0,24
(ESP) Spain	417830,00	32,22	2,26	6,77	5,13	14,27	3,64
(EST) Estonia	7620,00	39,62	13,63	15,33	1,24	7,48	1,63
(FRA) France	298110,00	72,51	12,78	32,22	3,24	10,76	13,24
(HRV) Croatia	81460,00	9,11	1,91	1,99	1,83	1,82	1,35
(HUN) Hungary	102100,00	20,81	2,63	3,28	1,40	8,08	5,26
(IRE) Ireland	86380,00	58,67	13,96	38,95	5,31	0,09	0,03
(ITA) Italy	532660,00	19,88	3,10	5,34	1,56	6,25	3,49
(LTU) Lithuania	61710,00	11,98	4,69	5,02	0,24	1,60	0,36
(LUX) Luxembourg	1600,00	112,70	29,12	65,16	0,54	17,36	0,23
(LVA) Latvia	24680,00	21,54	6,84	7,17	0,30	6,93	0,23
(MLT) Malta	2830,00	16,24	2,52	2,04	0,56	6,75	4,27
(NED) Netherlands	49520,00	135,16	33,04	25,30	2,78	50,52	22,87
(OST) Austria	91290,00	24,45	6,12	8,64	0,54	7,32	1,58
(POL) Poland	735170,00	12,09	3,07	3,37	0,08	3,78	1,67
(POR) Portugal	97690,00	15,08	2,01	6,75	3,14	0,51	2,57
(ROU) Romania	1133230,00	4,57	1,37	0,56	1,65	0,57	0,31
(SUO) Finland	36630,00	30,03	8,00	9,84	0,25	8,96	2,80
(SVE) Sweden	27990,00	76,04	13,77	27,64	0,97	23,76	9,56
(SVK) Slovakia	3650,00	143,09	38,08	57,43	10,39	20,15	16,74
(SVN) Slovenia	43930,00	9,96	2,28	5,09	0,41	1,37	0,58
(UKI) United Kingdom	97580,00	135,50	18,41	51,27	30,78	17,55	16,79
Average		52,94	11,02	18,43	3,07	15,03	5,13

16.1 Animal growth data

Using Seasons 19, animal growth rate is controlled by a set of growth parameters unique to each animal type and breed. FS19_RealLifeNumbers does not modify these growth parameters. In the following tables are listed example growth data for the different animal types. These numbers are taken from the internet and may not agree 100% with the growth rate set up by Seasons 19.

Table 61. Weight chart for pigs.

	weeks	Weight kg	Water L/day	Accum L/pig	Feed kg/day	Accum kg/pig	Gain kg/day	Manure kg/day	Manure kg/week	Accum kg/pig
	1	2.27						0.13	0.92	0.9
Creep	2	3.63						0.22	1.53	2.5
	3	6						0.37	2.61	5.1
	4	7.5	0.90	6	0.25	1.8	0.25	0.47	3.30	8.4
	5	9.5	1.40	16	0.41	4.6	0.35	0.60	4.21	12.6
	6	13	1.90	29	0.58	8.7	0.45	0.83	5.80	18.4
	7	17	2.20	45	0.74	13.8	0.57	1.09	7.62	26.0
	8	21	2.50	62	0.9	20.1	0.69	1.35	9.44	35.4
Growers	9	28	2.75	82	1.1	27.8	0.73	1.80	12.63	48.1
	10	34	3.00	103	1.2	36.2	0.77	2.19	15.36	63.4
	11	41	3.30	126	1.5	46.7	0.80	2.65	18.55	82.0
	12	47	3.60	151	1.5	57.2	0.84	3.04	21.28	103.2
Finishers	13	54	3.90	178	1.7	69.1	0.87	3.50	24.47	127.7
	14	61	4.20	208	1.9	82.4	0.90	3.95	27.65	155.4
	15	67	4.50	239	2.1	97.1	0.93	4.34	30.38	185.8
	16	74	4.80	273	2.2	112.5	0.96	4.80	33.57	219.3
Slaughter	17	81	5.15	309	2.4	129.3	0.98	5.25	36.76	256.1
	18	88	5.50	347	2.6	147.5	1.01	5.71	39.94	296.0
	19	94	5.75	387	2.8	167.1	1.03	6.10	42.68	338.7
	20	101	6.00	429	3.1	188.8	1.05	6.55	45.86	384.6
	21	108	6.30	474	3.3	211.9	1.07	7.01	49.05	433.6
	22	115	6.60	520	3.5	236.4	1.08	7.46	52.24	485.8
	23	122	6.90	568	3.7	262.3	1.09	7.92	55.42	541.3
	24	129	7.20	618	3.9	289.6	1.10	8.37	58.61	599.9
	25	137	7.73	673	4.09	318.2	1.10	8.89	62.25	662.1
	26	145	8.11	729	4.31	348.4	1.10	9.41	65.89	728.0
Sows		180	17.50	3150.0	3.3	592.0		11.69	81.83	2104.0

Table 62. Weight chart for cows. DM: Dry matter.

Month	Holstein lb	Weight kg	Water L/day	Accum L/animal	Gain kg/day	Energy need MJ/day	Feed DM kg/kg BW	Feed DM kg/day	Manure kg/day	Accum kg/animal
0	90	41		0	0.4	7.9			3.0	91.0
1	119	54	6	180	0.44	19.6			4.1	214.6
2	161	73	7.5	405	0.64	24.6	Milk + Milk replacer and grain starter mix		5.7	385.1
3	211	96	9.25	683	0.76	30.1			7.6	611.7
4	258	117	12.3	1052	0.71	35.0			9.3	890.9
5	311	141	14.4	1484	0.80	40.3			11.3	1229.5
6	369	167	15.8	1958	0.88	45.8		0.00	13.5	1633.0
7	422	192	17.1	2472	0.80	50.7	0.033	6.32	15.4	2095.9
8	468	212	18.3	3020	0.70	54.8	0.033	7.01	17.1	2610.3
9	530	241	19.8	3614	0.94	60.1	0.033	7.94	19.5	3194.2
10	575	261	20.9	4241	0.68	63.9	0.033	8.61	21.1	3828.4
11	638	290	22.5	4915	0.95	69.1	0.033	9.56	23.5	4533.2
12	682	310	23.5	5621	0.67	72.6	0.033	10.22	25.1	5287.4
13	728	330	24.7	6361	0.70	76.3	0.033	10.91	26.9	6093.0
14	776	352	25.9	7137	0.73	80.0	0.033	11.62	28.6	6952.4
15	843	383	27.5	7962	1.01	85.1	0.033	12.63	31.1	7886.8
16	913	414	29.2	8839	1.06	90.4	0.033	13.68	33.8	8899.6
17	931	423	29.7	9729	0.27	91.7	0.033	13.95	34.4	9932.6
18	969	440	30.6	10648	0.57	94.5	0.033	14.52	35.9	11008.2
19	1007	457	31.5	11594	0.57	97.3	0.033	15.08	37.3	12126.3
20	1050	477	32.6	12572	0.65	100.4	0.033	15.73	38.9	13292.6
21	1100	499	33.8	13587	0.76	103.9	0.033	16.48	40.7	14514.9
22	1150	522	35.1	14639	0.76	107.5	0.033	17.23	42.6	15793.2
23	1200	545	36.3	15728	0.76	111.0	0.033	17.98	44.5	17127.5
Cows	Annual	640	102	37156			0.026	16.90	52.3	18833.0

Table 63. Sheep growth and feed intake.

	Merino ram					Dorset wethers				
Weeks	Feed kg/week	Accum kg	Weight kg	Weight gain kg/week	Gain/feed kg/kg	Feed kg/week	Accum kg	Weight kg	Weight gain kg/week	Gain/feed kg/kg
1	1.08	1.08	5.71	0.50	0.46	0.84	0.84	4.96	0.36	0.43
2	2.11	3.2	6.21	0.73	0.35	1.64	2.5	5.32	0.53	0.32
3	3.08	6.3	6.94	0.94	0.30	2.40	4.9	5.85	0.68	0.28
4	4.00	10.3	7.88	1.13	0.28	3.12	8.0	6.53	0.82	0.26
5	4.87	15.1	9.01	1.31	0.27	3.80	11.8	7.35	0.95	0.25
6	5.68	20.8	10.32	1.47	0.26	4.44	16.2	8.31	1.07	0.24
7	6.46	27.3	11.78	1.61	0.25	5.05	21.3	9.38	1.18	0.23
8	7.19	34.5	13.39	1.74	0.24	5.63	26.9	10.56	1.28	0.23
9	7.88	42.3	15.13	1.85	0.23	6.17	33.1	11.84	1.37	0.22
10	8.53	50.9	16.97	1.94	0.23	6.69	39.8	13.21	1.44	0.22
11	9.14	60.0	18.92	2.03	0.22	7.17	46.9	14.65	1.51	0.21
12	9.71	69.7	20.95	2.10	0.22	7.63	54.6	16.16	1.56	0.21
13	10.26	80.0	23.04	2.15	0.21	8.06	62.6	17.72	1.61	0.20
14	10.77	90.7	25.19	2.20	0.20	8.47	71.1	19.33	1.65	0.20
15	11.25	102.0	27.39	2.23	0.20	8.85	79.9	20.99	1.68	0.19
16	11.70	113.7	29.62	2.26	0.19	9.21	89.2	22.67	1.71	0.19
17	12.12	125.8	31.88	2.27	0.19	9.55	98.7	24.38	1.73	0.18
18	12.51	138.3	34.15	2.28	0.18	9.87	108.6	26.11	1.74	0.18
19	12.89	151.2	36.43	2.28	0.18	10.16	118.7	27.84	1.74	0.17
20	13.23	164.4	38.71	2.27	0.17	10.44	129.2	29.59	1.74	0.17
21	13.56	178.0	40.98	2.25	0.17	10.70	139.9	31.33	1.74	0.16
22	13.86	191.9	43.23	2.23	0.16	10.94	150.8	33.07	1.73	0.16
23	14.14	206.0	45.46	2.21	0.16	11.17	162.0	34.80	1.72	0.15
24	14.41	220.4	47.67	2.18	0.15	11.38	173.4	36.52	1.70	0.15
25	14.65	235.1	49.85	2.15	0.15	11.57	185.0	38.23	1.68	0.15
26	14.88	249.9	52.00	2.11	0.14	11.75	196.7	39.91	1.66	0.14
27	15.09	265.0	54.11	2.07	0.14	11.92	208.6	41.57	1.64	0.14
28	15.28	280.3	56.18	2.03	0.13	12.07	220.7	43.21	1.61	0.13
29	15.46	295.8	58.21	1.99	0.13	12.21	232.9	44.82	1.58	0.13
30	15.62	311.4	60.20	1.94	0.12	12.34	245.3	46.40	1.55	0.13
31	15.77	327.1	62.14	1.90	0.12	12.46	257.7	47.95	1.52	0.12
32	15.91	343.1	64.04	1.85	0.12	12.56	270.3	49.47	1.49	0.12
33	16.04	359.1	65.89	1.80	0.11	12.66	282.9	50.96	1.46	0.11
34	16.15	375.2	67.69	1.75	0.11	12.74	295.7	52.42	1.42	0.11
35	16.25	391.5	69.44	1.70	0.10	12.81	308.5	53.84	1.39	0.11
36	16.34	407.8	71.14	1.65	0.10	12.88	321.4	55.22	1.35	0.11
37	16.42	424.3	72.79	1.61	0.10	12.94	334.3	56.58	1.32	0.10
38	16.49	440.7	74.40	1.56	0.09	12.99	347.3	57.89	1.28	0.10
39	16.56	457.3	75.96	1.51	0.09	13.03	360.3	59.18	1.25	0.10
40	16.61	473.9	77.46	1.46	0.09	13.06	373.4	60.43	1.21	0.09
41	16.65	490.6	78.93	1.42	0.08	13.08	386.4	61.64	1.18	0.09
42	16.69	507.3	80.34	1.37	0.08	13.10	399.6	62.82	1.15	0.09
43	16.72	524.0	81.71	1.32	0.08	13.11	412.7	63.96	1.11	0.08
44	16.74	540.7	83.04	1.28	0.08	13.12	425.8	65.07	1.08	0.08
45	16.76	557.5	84.32	1.24	0.07	13.12	438.9	66.15	1.05	0.08
46	16.77	574.2	85.55	1.20	0.07	13.11	452.0	67.20	1.01	0.08
47	16.77	591.0	86.75	1.15	0.07	13.10	465.1	68.21	0.98	0.08
48	16.77	607.8	87.90	1.11	0.07	13.08	478.2	69.20	0.95	0.07
49	16.76	624.5	89.02	1.08	0.06	13.06	491.2	70.15	0.92	0.07
50	16.75	641.3	90.09	1.04	0.06	13.03	504.3	71.07	0.89	0.07
51	16.73	658.0	91.13	1.00	0.06	13.00	517.3	71.96	0.86	0.07
52	16.70	674.7	92.13			12.96	530.2	72.83		

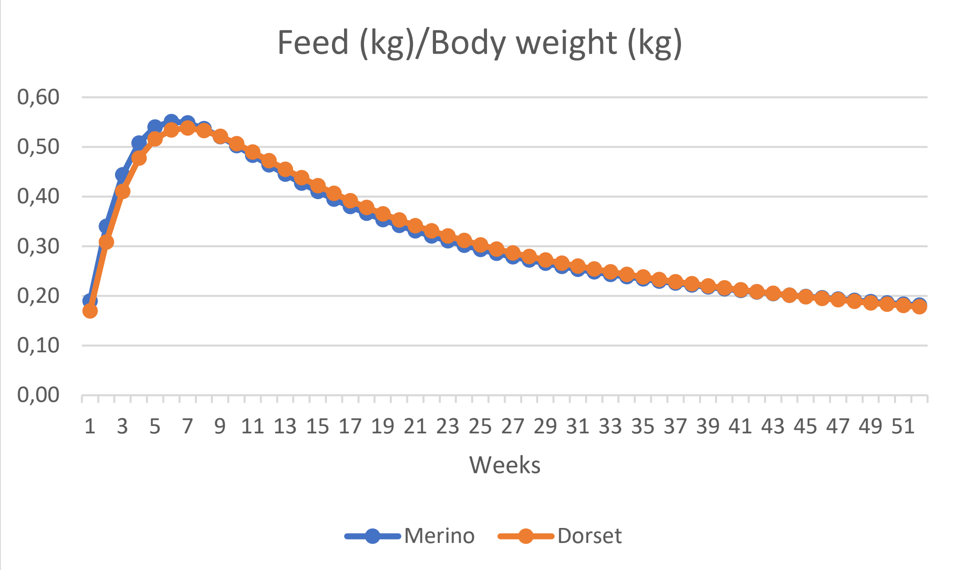

Figure 21. Feed intake in kilogram per body weight in kilogram.

Data for Table 63 and Figure 21 are from J.M. Thompson and J.R. Parks, Anim. Prod. Vol. 36, p. 471-479, 1983.

In FS19, chicken do not take water or straw, only feed. Mature chickens eat about 0.11 kg/day (see Table 64 and Table 65).

Table 64. Weight chart for chicken (layers).

AGE (WEEK)	AVERAGE BODY WEIGHT	AVERAGE FEED INTAKE	CUMULATIVE FEED INTAKE	AVERAGE WATER INTAKE
	(kg/bird)	(g/bird/day)	(kg to date)	(ml/bird/day)
1	0.065	14.5	0.1015	25.5
2	0.125	19	0.2345	38
3	0.19	24	0.4025	46.5
4	0.265	28	0.5985	56.5
5	0.36	35	0.8435	65.5
6	0.46	39	1.1165	71.5
7	0.56	42	1.4105	78
8	0.67	47	1.7395	87
9	0.78	56	2.1315	93
10	0.89	54	2.5095	101
11	0.99	60	2.9295	109.5
12	1.08	64	3.3775	117.5
13	1.165	69	3.8605	124.5
14	1.23	72	4.3645	128.5
15	1.3	74	4.8825	133
16	1.37	77	5.4215	138.5
17 egg laying	1.44	80	5.9815	146.5
18	1.52	85	6.5765	152.5
19	1.62	88	7.1925	161
20	1.68	94	7.8505	169.5
21	1.72	98	8.5365	176.5
22	1.77	102	9.2505	183.5
23	1.8	106	9.9925	188.5
24	1.84	108	10.7485	191
25	1.85	109	11.5115	192.5
26	1.86	110	12.2815	193.5
27	1.88	110	13.0515	193.5
28	1.89	110	13.8215	193.5
29	1.9	110	14.5915	193.5
30	1.9	110	15.3615	193.5
31	1.9	111	16.1385	195
32	1.91	111	16.9155	195
33	1.91	111	17.6925	195
34	1.91	111	18.4695	195
35	1.91	111	19.2465	195
36	1.92	111	20.0235	195

37	1.92	111	20.8005	195
38	1.92	111	21.5775	195
39	1.93	111	22.3545	195
40	1.93	111	23.1315	195
41	1.93	111	23.9085	195
42	1.94	111	24.6855	195
43	1.94	111	25.4625	195
44	1.94	110.5	26.236	195
45	1.95	110	27.006	193.5
46	1.95	110	27.776	193.5
47	1.95	110	28.546	193.5
48	1.95	110	29.316	193.5
49	1.95	110	30.086	193.5
50	1.95	109.5	30.8525	193.5
51	1.95	109	31.6155	191.5
52	1.95	109	32.3785	191.5
53	1.95	109	33.1415	191.5
54	1.95	109	33.9045	191.5
55	1.96	109	34.6675	191.5
56	1.96	109	35.4305	191.5
57	1.96	109	36.1935	191.5
58	1.96	109	36.9565	191.5
59	1.96	109	37.7195	191.5
60	1.96	109	38.4825	191.5
61	1.96	109	39.2455	191.5
62	1.96	109	40.0085	191.5
63	1.96	109	40.7715	191.5
64	1.96	109	41.5345	191.5
65	1.96	109	42.2975	191.5
66	1.96	109	43.0605	191.5
67	1.96	109	43.8235	191.5
68	1.96	109	44.5865	191.5
69	1.96	109	45.3495	191.5
70	1.97	109	46.1125	191.5
71	1.97	109	46.8755	191.5
72	1.97	109	47.6385	191.5
73	1.97	109	48.4015	191.5
74	1.97	109	49.1645	191.5
75	1.97	109	49.9275	191.5
76	1.97	109	50.6905	191.5
77	1.97	109	51.4535	191.5

Table 65. Broiler weight chart.

AGE (DAYS)	FEED CONSUMED PER BIRD (KG)	CUMULATIVE FEED CONSUMED PER BIRD (KG)	AVERAGE BODY WEIGHT (KG)	AVERAGE BODY WEIGHT GAIN PER BIRD (KG)
0	0	0	0.042	0
1	0.013	0.013	0.056	0.014
2	0.016	0.029	0.07	0.014
3	0.02	0.049	0.087	0.017
4	0.023	0.072	0.106	0.019
5	0.026	0.098	0.128	0.022
6	0.03	0.128	0.152	0.024
7	0.035	0.163	0.179	0.027
8	0.038	0.201	0.208	0.029
9	0.042	0.243	0.241	0.033
10	0.047	0.29	0.276	0.035
11	0.052	0.342	0.315	0.039
12	0.057	0.399	0.357	0.042
13	0.062	0.461	0.402	0.045
14	0.067	0.528	0.45	0.048
15	0.073	0.601	0.501	0.051
16	0.078	0.679	0.555	0.054
17	0.084	0.763	0.612	0.057
18	0.09	0.853	0.672	0.06
19	0.096	0.949	0.734	0.062
20	0.102	1.051	0.8	0.066
21	0.108	1.159	0.868	0.068
22	0.114	1.273	0.938	0.07
23	0.12	1.393	1.011	0.073
24	0.126	1.519	1.086	0.075
25	0.132	1.651	1.164	0.078
26	0.137	1.788	1.243	0.079
27	0.144	1.932	1.323	0.08
28	0.148	2.08	1.406	0.083
29	0.155	2.235	1.49	0.084
30	0.159	2.394	1.575	0.085

31	0.165	2.559	1.661	0.086
32	0.17	2.729	1.748	0.087
33	0.175	2.904	1.836	0.088
34	0.179	3.083	1.924	0.088
35	0.183	3.266	2.013	0.089
36	0.188	3.454	2.102	0.089
37	0.191	3.645	2.192	0.09
38	0.196	3.841	2.281	0.089
39	0.198	4.039	2.37	0.089
40	0.203	4.242	2.459	0.089
41	0.205	4.447	2.548	0.089
42	0.208	4.655	2.637	0.089

16.2 Animal intake and output

The following tables enable the user to modify some parameters set in the Seasons mod.

16.2.1 Pig intake and output (typical for Germany).

```
RNS.pigs.color                 = {     "RED",          "WHITE",              "BLACK_WHITE",          "BLACK"      };
RNS.pigs.type                  = { "Yorkshire","Gloucestershire Old Spot","Spotted",          "Berkshire"   };
RNS.pigs.fillType              = {      73,              74,                   75,                   76       };
RNS.pigs.strawPerDay           = {    0.25,            0.25,                 0.25,                 0.25      };
RNS.pigs.waterPerDayPerKg      = {    0.03,            0.03,                 0.03,                 0.03      };
RNS.pigs.foodPerDayPerKg       = {    0.03,            0.03,                 0.03,                 0.03      };
RNS.pigs.foodTroughFraction    = {       1,               1,                    1,                    1      };
RNS.pigs.buyWeight             = {   190.0,              24,                  145,                 26.0      };
RNS.pigs.bornWeight            = {   1.575,           1.125,                 1.35,                1.575      };
RNS.pigs.milkPerDay            = {    0.00,            0.00,                 0.00,                 0.00      };
RNS.pigs.manurePerDayPerKg     = {   0.065,           0.065,                0.065,                0.065      };
RNS.pigs.liquidManure          = {   0.039,           0.039,                0.039,                0.039      };
RNS.pigs.foodSpillage          = {    0.00,            0.00,                 0.00,                 0.00      };
RNS.pigs.fertileAge            = {     0.4,               0,                  0.4,                    0      };
RNS.pigs.averageLitterSize     = {      14,               0,                   14,                    0      };
RNS.pigs.variationLitterSize   = {       2,               0,                    2,                    0      };
RNS.pigs.birthRate             = {       8,               0,                    8,                    0      };
RNS.pigs.femalePercentage      = {     0.9,               0,                  0.9,                    0      };
RNS.pigs.dailyUpkeep           = {       0,               0,                    0,                    0      };
RNS.pigs.buyPriceMultiplier    = {     1.2,             1.2,                  1.2,                  1.2      };
RNS.pigs.baseSellPrice         = {       0,               0,                    0,                    0      };
RNS.pigs.pricePerKg            = {    1.33,            1.57,                 1.33,                 1.57      };
RNS.pigs.priceDropAge          = {     180,             180,                  180,                  180      };
RNS.pigs.transportPrice        = {      10,              10,                   10,                   10      };
RNS.pigs.buyAge                = {     365,              56,                  365,                   56      };
RNS.pigs.buyIsFemale           = {    true,           false,                 true,                false      };
```

16.2.2 Cow intake and output (typical for Germany).

```
RNS.cows1.color              = {  "BROWN",     "BROWN_WHITE",  "BLACK",   "BLACK_WHITE"  };
RNS.cows1.type               = { "Limousin",   "Ayrshire",     "Saler",   "Holstein"     };
RNS.cows1.fillType           = {   61,           62,             63,        64           };
RNS.cows1.strawPerDay        = {   1.4,          1.4,            1.4,       1.4          };
RNS.cows1.waterPerDayPerKg   = {   0.09,         0.17,           0.09,      0.17         };
RNS.cows1.foodPerDayPerKg    = {   0.069,        0.069,          0.069,     0.069        };
RNS.cows1.foodTroughFraction = {   0.05,         0.1,            0.05,      0.1          };
RNS.cows1.buyWeight          = {   280,          410,            275,       490          };
RNS.cows1.bornWeight         = {   40.05,        32.40,          38.00,     40.50        };
RNS.cows1.milkPerDay         = {   0.00,         25.00,          0.00,      29.00        };
RNS.cows1.manurePerDayPerKg  = {   0.082,        0.082,          0.082,     0.082        };
RNS.cows1.liquidManure       = {   0.080,        0.130,          0.080,     0.130        };
RNS.cows1.foodSpillage       = {   0.00,         0.00,           0.00,      0.00         };
RNS.cows1.fertileAge         = {   0,            2,              0,         0.25         };
RNS.cows1.averageLitterSize  = {   0,            1,              0,         1            };
RNS.cows1.variationLitterSize= {   0,            0,              0,         0            };
RNS.cows1.birthRate          = {   0,            4,              0,         4            };
RNS.cows1.femalePercentage   = {   0,            0.9,            0,         0.9          };
RNS.cows1.dailyUpkeep        = {   0,            0,              0,         0            };
RNS.cows1.buyPriceMultiplier = {   1.2,          1.2,            1.2,       1.2          };
RNS.cows1.baseSellPrice      = {   0,            0,              0,         0            };
RNS.cows1.pricePerKg         = {   1.92,         1.98,           1.92,      1.98         };
RNS.cows1.priceDropAge       = {   1100,         1100,           1100,      1100         };
RNS.cows1.transportPrice     = {   20,           20,             20,        20           };
RNS.cows1.buyAge             = {   230,          700,            300,       700          };
RNS.cows1.buyIsFemale        = {   false,        true,           false,     true         };
```

16.2.3 Sheep intake and output (typical for Germany).

```
RNS.sheep.color               = {  "WHITE",    "BROWN",    "BLACK_WHITE",  "BLACK"   };
RNS.sheep.type                = { "Dorset",    "Merino",   "Suffolk",      "Dorper"  };
RNS.sheep.fillType            = {   69,          70,         71,             72      };
RNS.sheep.strawPerDay         = {   0.0,         0.0,        0.0,            0.0     };
RNS.sheep.waterPerDayPerKg    = {   0.04,        0.04,       0.04,           0.04    };
RNS.sheep.foodPerDayPerKg     = {   0.085,       0.085,      0.085,          0.085   };
RNS.sheep.foodTroughFraction  = {   0.1,         0.1,        0.1,            0.1     };
RNS.sheep.buyWeight           = {   65.0,        50,         70,             60      };
RNS.sheep.bornWeight          = {   4.77,        5.45,       6.255,          5.445   };
RNS.sheep.milkPerDay          = {   0.00,        0.00,       0.00,           0.00    };
RNS.sheep.manurePerDayPerKg   = {   0.00,        0.00,       0.00,           0.00    };
RNS.sheep.liquidManure        = {   0.00,        0.00,       0.00,           0.00    };
RNS.sheep.foodSpillage        = {   0.00,        0.00,       0.00,           0.00    };
RNS.sheep.woolKgPerYear       = {   3.20,        3.20,       3.20,           0       };
RNS.sheep.fertileAge          = {   0.6,         0.6,        0.6,            0.6     };
RNS.sheep.averageLitterSize   = {   1.55,        1.23,       1.65,           1.8     };
RNS.sheep.variationLitterSize = {   1,           1,          1,              1       };
RNS.sheep.birthRate           = {   6,           6,          6,              6       };
RNS.sheep.femalePercentage    = {   0.5,         0.5,        0.5,            0.5     };
RNS.sheep.dailyUpkeep         = {   0,           0,          0,              0       };
RNS.sheep.buyPriceMultiplier  = {   1.2,         1.2,        1.2,            1.2     };
RNS.sheep.baseSellPrice       = {   0,           0,          0,              0       };
RNS.sheep.pricePerKg          = {   2.55,        2.55,       2.55,           2.55    };
RNS.sheep.priceDropAge        = {   100,         100,        100,            100     };
RNS.sheep.transportPrice      = {   10,          10,         10,             10      };
RNS.sheep.buyAge              = {   365,         365,        365,            365     };
RNS.sheep.buyIsFemale         = {   true,        true,       true,           true    };
```

A sheep's wool production is set to 3.2 kg/year. With a bale density of 0.375 kg/L this amounts to 8.5 liters of a 1000 liter wool pallet. Hence it requires 117 sheep to produce one wool pallet per year; much less than in the standard game[4].

[4] SHEEP 201, A beginner's Guide to Raising Sheep. http://www.sheep101.info/201/

16.2.4 Goats intake and output (typical for Germany).

```
RNS.goats.color                = {   "BROWN",        "WHITE",         "BLACK"        };
RNS.goats.type                 = { "Brown goat",   "White goat",    "Black goat"     };
RNS.goats.fillType             = {     122,           123,             124           };
RNS.goats.strawPerDay          = {     0.35,          0.35,            0.35          };
RNS.goats.waterPerDayPerKg     = {     0.29,          0.29,            0.29          };
RNS.goats.foodPerDayPerKg      = {    0.140,         0.140,           0.140          };
RNS.goats.foodTroughFraction   = {      0.1,           0.1,             0.1          };
RNS.goats.buyWeight            = {      29,            29,              29           };
RNS.goats.bornWeight           = {     3.85,          3.85,            3.85          };
RNS.goats.milkPerDay           = {     4.10,          4.10,            4.10          };
RNS.goats.manurePerDayPerKg    = {     0.03,          0.03,            0.03          };
RNS.goats.liquidManure         = {     0.02,          0.02,            0.02          };
RNS.goats.foodSpillage         = {     0.00,          0.00,            0.00          };
RNS.goats.woolKgPerYear        = {     1.00,          1.00,            1.00          };
RNS.goats.fertileAge           = {      0.6,           0.6,             0.6          };
RNS.goats.averageLitterSize    = {     1.55,          1.55,            1.55          };
RNS.goats.variationLitterSize  = {        1,             1,               1          };
RNS.goats.birthRate            = {        6,             6,               6          };
RNS.goats.femalePercentage     = {      0.5,           0.5,             0.5          };
RNS.goats.dailyUpkeep          = {        0,             0,               0          };
RNS.goats.buyPriceMultiplier   = {      1.2,           1.2,             1.2          };
RNS.goats.baseSellPrice        = {        0,             0,               0          };
RNS.goats.pricePerKg           = {     3.16,          3.16,            3.16          };
RNS.goats.priceDropAge         = {      100,           100,             100          };
RNS.goats.transportPrice       = {       10,            10,              10          };
RNS.goats.buyAge               = {      210,           210,             210          };
RNS.goats.buyIsFemale          = {     true,          true,            true          };
```

16.2.5 Chicken intake and output (typical for Germany).

```
RNS.chicken.color               = {   "BLACK",         "WHITE",          "BROWN",           "ROOSTER"  };
RNS.chicken.type                = { "Cornish Cross", "White Leghorn", "Rhode Island Red",  "Rooster"   };
RNS.chicken.fillType            = {      77,             78,              79,                80       };
RNS.chicken.strawPerDay         = {     0.0,            0.0,             0.0,               0.0       };
RNS.chicken.waterPerDayPerKg    = {     0.1,            0.1,             0.1,               0.1       };
RNS.chicken.foodPerDayPerKg     = {  0.0545,         0.0545,          0.0545,            0.0545       };
RNS.chicken.buyWeight           = {    0.18,          2.138,           2.655,               6.0       };
RNS.chicken.bornWeight          = {   0.036,          0.020,           0.020,                 0       };
RNS.chicken.milkPerDay          = {    0.00,           0.00,            0.00,              0.00       };
RNS.chicken.manurePerDayPerKg= {      0.030,          0.030,           0.030,             0.030       };
RNS.chicken.liquidManure        = {    0.00,           0.00,            0.00,              0.00       };
RNS.chicken.foodSpillage        = {    0.00,           0.00,            0.00,              0.00       };
RNS.chicken.eggsPerYear         = {       0,            275,             275,                 0       };
RNS.chicken.fertileAge          = {       0,            0.4,             0.4,                 0       };
RNS.chicken.averageLitterSize= {          0,              1,               1,                 0       };
RNS.chicken.variationLitterSize= {        0,              0,               0,                 0       };
RNS.chicken.birthRate           = {       0,             10,              10,                 6       };
RNS.chicken.femalePercentage = {          0,            0.5,             0.5,                 0       };
RNS.chicken.dailyUpkeep         = {       0,              0,               0,                 0       };
RNS.chicken.buyPriceMultiplier   = {    1.2,            1.2,             1.2,               1.2       };
RNS.chicken.baseSellPrice       = {     0.5,            0.5,             0.5,               0.5       };
RNS.chicken.pricePerKg          = {    0.90,           0.90,            0.90,              0.90       };
RNS.chicken.priceDropAge        = {      30,             30,              30,                30       };
RNS.chicken.transportPrice      = {       0,              0,               0,                 0       };
RNS.chicken.buyAge              = {       7,            140,             140,               200       };
RNS.chicken.buyIsFemale         = {   false,           true,            true,             false       };
```

Chickens are set to lay 275 eggs per year.

16.2.6 Ducks intake and output (typical for Germany).

```
RNS.ducks.color              = {   "WHITE",        "BROWN",          "BLACK"    };
RNS.ducks.type               = { "White duck",  "Brown duck",    "Black duck"   };
RNS.ducks.fillType           = {     77,             78,               79       };
RNS.ducks.strawPerDay        = {     0.0,            0.0,              0.0      };
RNS.ducks.waterPerDayPerKg   = {     0.1,            0.1,              0.1      };
RNS.ducks.foodPerDayPerKg    = {  0.0545,         0.0545,           0.0545      };
RNS.ducks.buyWeight          = {   2.138,          2.138,            2.138      };
RNS.ducks.bornWeight         = {   0.020,          0.020,            0.020      };
RNS.ducks.milkPerDay         = {    0.00,           0.00,             0.00      };
RNS.ducks.manurePerDayPerKg  = {   0.030,          0.030,            0.030      };
RNS.ducks.liquidManure       = {    0.00,           0.00,             0.00      };
RNS.ducks.foodSpillage       = {    0.00,           0.00,             0.00      };
RNS.ducks.eggsPerYear        = {     275,            275,              275      };
RNS.ducks.fertileAge         = {     0.4,            0.4,              0.4      };
RNS.ducks.averageLitterSize  = {       1,              1,                1      };
RNS.ducks.variationLitterSize= {       0,              0,                0      };
RNS.ducks.birthRate          = {      10,             10,               10      };
RNS.ducks.femalePercentage   = {     0.5,            0.5,              0.5      };
RNS.ducks.dailyUpkeep        = {       0,              0,                0      };
RNS.ducks.buyPriceMultiplier   = {   1.2,            1.2,              1.2      };
RNS.ducks.baseSellPrice      = {       0,              0,                0      };
RNS.ducks.pricePerKg         = {    5.55,           5.55,             5.55      };
RNS.ducks.priceDropAge       = {      30,             30,               30      };
RNS.ducks.transportPrice     = {       1,              1,                1      };
RNS.ducks.buyAge             = {     140,            140,              140      };
RNS.ducks.buyIsFemale        = {    true,           true,             true      };
```

16.2.7 Horse intake and output (typical for Germany).

```
RNS.horses1.color             = {"HORSE_TYPE_GREY","HORSE_TYPE_BROWN_WHITE","HORSE_TYPE_BEIGE","HORSE_TYPE_RI
RNS.horses1.type              = {  "Andalusian",      "Paint",            "Haflinger",    "Quarter Horse"   };
RNS.horses1.fillType          = {      58,              56,                  53,              60          };
RNS.horses1.strawPerDay       = {       5,               5,                   5,               5          };
RNS.horses1.waterPerDayPerKg  = {   0.084,           0.084,               0.084,           0.084          };
RNS.horses1.foodPerDayPerKg   = {   0.025,           0.025,               0.025,           0.025          };
RNS.horses1.buyWeight         = {     545,             470,                 430,             455          };
RNS.horses1.bornWeight        = {       0,               0,                   0,               0          };
RNS.horses1.milkPerDay        = {    0.00,            0.00,                0.00,            0.00          };
RNS.horses1.manurePerDayPerKg= {     0.04,            0.04,                0.04,            0.04          };
RNS.horses1.liquidManure      = {   0.021,           0.021,               0.021,           0.021          };
RNS.horses1.foodSpillage      = {    0.00,            0.00,                0.00,            0.00          };
RNS.horses1.dailyUpkeep       = {       0,               0,                   0,               0          };
RNS.horses1.buyPriceMultiplier = {      0,               0,                   0,               0          };
RNS.horses1.baseSellPrice     = {       0,               0,                   0,               0          };
RNS.horses1.pricePerKg        = {       0,               0,                   0,               0          };
RNS.horses1.priceDropAge      = {       0,               0,                   0,               0          };
RNS.horses1.transportPrice    = {      50,              50,                  50,              50          };
RNS.horses1.buyAge            = {    1000,            1000,                1000,            1000          };
RNS.horses1.buyIsFemale       = {   false,           false,               false,           false          };
RNS.horses1.cleanDuration     = {    5000,            5000,                5000,            5000          };
RNS.horses1.liveryIncome      = {    5600,            4300,                5000,            4600          };
RNS.horses1.trainingDifficulty= {     1.5,             1.1,                 1.3,             1.2          };
```

With the Seasons mod, horses are not traded and do not produce output.

16.3 Annual feed, bale and land requirements.

When starting up a new map, it is very useful to know how much land is required for a given herd size of animals. One would like to know how much of needed crop types are required as well and how many hectares are needed with the required crop types. This will also enable the player to choose a field of a proper size for a given crop. The script **RealNumbersAnnualFeedPrediction.lua** provides this information based on typical input values controlled by the player.

Using the Seasons mod, feed intake is a function of body weight. So, for a precise calculation of annual feed intake, one would have to reproduce the exact growth curve generated in the Seasons mod. Since the information is scares about the growth curve parameters in the Seasons mod, this is not a viable approach. Instead, the present mod assumes a linear growth rate from a birthing weight to a slaughter weight. The model is illustrated in Figure 22.

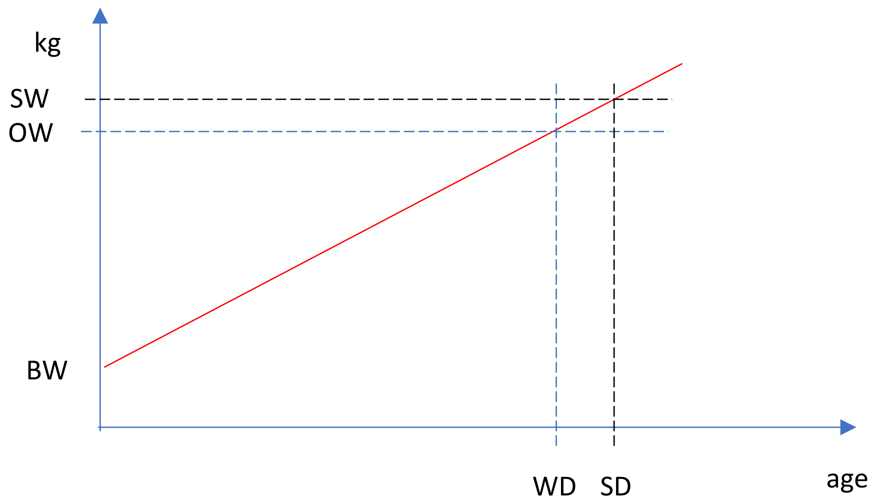

Figure 22. Linear growth model for predicting annual feed requirements.

If we know the birth weight (BW) and an observed weight (OW) at a known weighing day (WD), we can calculate the slope of the linearized growth curve:

$$slope = \frac{OW - BW}{WD}$$

Now we can calculate an estimated live weight (SW) on slaughter day (SD):

$$SW = slope \times SD + BW$$

Knowing the slaughter weight, we can calculate the average weight of the animal from the time of birth till slaughter day:

$$Mean\ weight = \frac{BW + SW}{2}$$

Knowing the amount of feed intake per day per kg body weight, we can now estimate the feed intake for one animal:

$$Feed\ intake = Mean\ weight \times slaghter\ day \times feed\ intake\ per\ day\ per\ kg\ body\ weight.$$

For mature, birth giving animals, we simply use their mature weight. The mod calculates the feed intake for mature animals, female offspring and male offspring and add it all up. For grazing animals, a large fraction of feed comes from grazing. Hence trough feed is set as a small percentage of total feed (5 or 10%).   Trough feed intake is then split up the feed components for that animal type.

If the Maize Plus mod and Maize Plus Extension is not used, then default feed compositions are used.

Table 66. Pig feed composition. Default without Maize Plus.

```
PIGS

Number of feed categories     : 3

Feed category                 : Base food
Production weight             : 0.5
Eat weight                    : 0.5
Feed content                  : MAIZE

Feed category                 : Grain
Production weight             : 0.25
Eat weight                    : 0.25
Feed content                  : WHEAT
Feed content                  : BARLEY

Feed category                 : Protein
Production weight             : 0.25
Eat weight                    : 0.25
Feed content                  : SOYBEAN
Feed content                  : CANOLA
Feed content                  : SUNFLOWER
```

If Maize Plus is used, feed compositions differ significantly.

Table 67. Pig feed composition. Default with Maize Plus

```
PIGS

Number of feed categories      : 4

Feed category                  : base
Production weight              : 0.18000000715256
Eat weight                     : 0.18000000715256
Feed content                   : GRASS_WINDROW
Feed content                   : CLOVER_WINDROW
Feed content                   : CHOPPEDMAIZE

Feed category                  : grain
Production weight              : 0.34999999403954
Eat weight                     : 0.34999999403954
Feed content                   : MAIZE
Feed content                   : WHEAT
Feed content                   : BARLEY

Feed category                  : protein
Production weight              : 0.30000001192093
Eat weight                     : 0.30000001192093
Feed content                   : SOYBEAN
Feed content                   : CANOLA
Feed content                   : SUNFLOWER

Feed category                  : earth
Production weight              : 0.17000000178814
Eat weight                     : 0.17000000178814
Feed content                   : POTATO
Feed content                   : SUGARBEET
Feed content                   : CARROT
```

Knowing the feed intake per kg body weight per day, we need to estimate the average weight of the animal while living in the pen. Data tables for this is found in the script **RealNumbersAnnualFeedPrediction.lua**. An example is shown in Figure 23.

```
RNS.cowsl.color              = {  "BROWN",     "BROWN_WHITE",   "BLACK",   "BLACK_WHITE"  };
RNS.cowsl.type               = { "Limousin",   "Ayrshire",      "Saler",   "Holstein"     };
RNS.cowsl.matureWeight       = {  1000,         540,            1000,       680           };
RNS.cowsl.weightDay          = {   365,         365,             365,       365           };
RNS.cowsl.weightM            = {   566,         480,             516,       495           };
RNS.cowsl.weightF            = {   420,         300,             396,       309           };
RNS.cowsl.linGrowthPct       = {    85,          85,              85,        85           };
RNS.cowsl.monthsToLevelOut   = {    24,          24,              24,        24           };
RNS.cowsl.slaughterAge       = {   365,         365,             365,       365           };
RNS.cowsl.numberMature       = {    10,           0,               0,        20           };
RNS.cowsl.strawPercentage    = {    25,          25,              25,        25           };
RNS.cowsl.hayPercentage      = {    50,          50,              50,        50           };
RNS.cowsl.silagePercentage   = {    25,          25,              25,        25           };
RNS.cowsl.roundBaleVolume    = {  1500,        1500,            1500,      1500           };
RNS.cowsl.squareBaleVolume   = {  2600,        2600,            2600,      2600           };
```

Figure 23. Input parameters for estimating feed intake for cows. Weight is in kg and age in days.

These data have no influence on the actual growth rate in the game. They are just typical data used to predict the average weight of an animal gaining weight linearly.

Table 68. Estimated need of feed, bales and hectares for 10 Limousin steers and 20 Holstein cows.

		Limousin	Ayrshire	Saler	Holstein	
Number of mature animals	=	10	0	0	20	
Number of offsprings, males	=	0	0	0	2	
Number of offsprings, females	=	0	0	0	18	
Average weight males	=	303	256	277	268	kg
Average weight females	=	230	166	217	175	kg
Average weight gain, males	=	1.4410	1.2263	1.3096	1.2452	kg/day
Average weight gain, females	=	1.0410	0.7332	0.9808	0.7356	kg/day
Slaughter age	=	365	365	365	365	days
Slaughter weight, male	=	566	480	516	495	kg
Slaughter weight, female	=	420	300	396	309	kg
Herd manure per year	=	29930	16162	29930	130525	L/year
Herd slurry per year	=	29200	25623	29200	206929	L/year
Herd bedding straw	=	39308	0	0	157231	L/year
Round straw bales/year	=	26	0	0	105	
Square straw bales/year	=	15	0	0	60	
Water per year	=	328500	0	0	1072286	L/year
Herd feed intake	=	251850	0	0	435222	kg/year
Herd trough feed	=	12593	0	0	43522	kg/year
Feedmix density	=	0.3762	0.3762	0.3762	0.3762	kg/L
Herd Feedmix volume	=	33468	0	0	115674	L/year
CHOPPEDMAIZE_FERMENTED						
Volume fraction =	=	0.3500				
Herd trough	=	11714	0	0	40486	L/year
Round bales	=	8	0	0	27	
Square bales	=	5	0	0	16	
Hectares	=	0.2681	0.0000	0.0000	0.9264	Ha
GRASS_FERMENTED						
Volume fraction =	=	0.3500				
Herd trough	=	11714	0	0	40486	L/year
Round bales	=	8	0	0	27	
Square bales	=	5	0	0	16	
Hectares	=	0.2235	0.0000	0.0000	0.7724	Ha
SILAGE						
Volume fraction =	=	0.3500				
Herd trough	=	11714	0	0	40486	L/year
Round bales	=	8	0	0	27	
Square bales	=	5	0	0	16	
Hectares	=	0.2235	0.0000	0.0000	0.7724	Ha
DRYGRASS_WINDROW						
Volume fraction =	=	0.2500				
Herd trough	=	8367	0	0	28918	L/year
Round bales	=	6	0	0	19	
Square bales	=	3	0	0	11	
Hectares	=	0.1803	0.0000	0.0000	0.6233	Ha
DRYCLOVER_WINDROW						
Volume fraction =	=	0.2500				
Herd trough	=	8367	0	0	28918	L/year
Round bales	=	6	0	0	19	
Square bales	=	3	0	0	11	
Hectares	=	0.1963	0.0000	0.0000	0.6786	Ha
DRYALFALFA_WINDROW						
Volume fraction =	=	0.2500				
Herd trough	=	8367	0	0	28918	L/year
Round bales	=	6	0	0	19	
Square bales	=	3	0	0	11	
Hectares	=	0.2830	0.0000	0.0000	0.9782	Ha
HAYPELLETS						
Volume fraction =	=	0.2500				
Herd trough	=	8367	0	0	28918	L/year
Hectares	=	0.0000	0.0000	0.0000	0.0000	Ha
CLOVER_FERMENTED						
Volume fraction =	=	0.2000				
Herd trough	=	6694	0	0	23135	L/year
Round bales	=	4	0	0	16	
Square bales	=	3	0	0	9	
Hectares	=	0.1374	0.0000	0.0000	0.4749	Ha
ALFALFA_FERMENTED						
Volume fraction =	=	0.2000				
Herd trough	=	6694	0	0	23135	L/year
Round bales	=	4	0	0	16	
Square bales	=	3	0	0	9	
Hectares	=	0.1803	0.0000	0.0000	0.6233	Ha

GRASS_WINDROW						
Volume fraction =	=	0.2000				
Herd trough	=	6694	0	0	23135	L/year
Round bales	=	4	0	0	16	
Square bales	=	3	0	0	9	
Hectares	=	0.1277	0.0000	0.0000	0.4414	Ha
CLOVER_WINDROW						
Volume fraction =	=	0.2000				
Herd trough	=	6694	0	0	23135	L/year
Round bales	=	4	0	0	16	
Square bales	=	3	0	0	9	
Hectares	=	0.1374	0.0000	0.0000	0.4749	Ha
CHOPPEDMAIZE						
Volume fraction =	=	0.2000				
Herd trough	=	6694	0	0	23135	L/year
Round bales	=	4	0	0	16	
Square bales	=	3	0	0	9	
Hectares	=	0.1532	0.0000	0.0000	0.5294	Ha

Adding up the feed need for all animal types and dividing by the crop yield, we get an estimate of how many hectares are needed for each feed crop. The result is shown in

Table 69. Feed crop hectares needed.

CANOLA	=	26.9531	ha
MAIZE	=	5.3152	ha
DRYALFALFA_WINDROW	=	1.7444	ha
SUGARBEET	=	0.8485	ha
WHEAT	=	13.9460	ha
SUNFLOWER	=	18.3210	ha
CLOVER	=	0.6062	ha
GRASS_FERMENTED	=	1.5409	ha
CARROT	=	0.7785	ha
HEMP_WINDROW	=	0.7772	ha
CLOVER_WINDROW	=	1.7231	ha
REDCABBAGE	=	0.0783	ha
CLOVER_FERMENTED	=	1.1987	ha
DRYCLOVER_WINDROW	=	1.2102	ha
SOYBEAN	=	15.7747	ha
POTATO	=	0.7889	ha
SILAGE	=	0.9958	ha
CHOPPEDMAIZE	=	1.9210	ha
BARLEY	=	13.8871	ha
ALFALFA_FERMENTED	=	0.8036	ha
GRASS_WINDROW	=	2.1945	ha
CHOPPEDMAIZE_FERMENTED	=	1.1945	ha
DRYGRASS_WINDROW	=	1.7815	ha

We do not need all feed types listed. Different feed types belong to the same feed group and we only need one feed crop from each feed groups. Table 70 list the different feed groups defined by the mod MaisePlus. If we have all animal types mentioned in the table, the need for fresh forage, silage and hay is best covered by grass. Clover silage bales could be purchased. Wheat should be the first source of grain and oat for horses should be purchased. Soybean should be the source of protein, and sugarbeet the source of earth fruit. Carrots should be purchased for horses.

Table 70. Feed groups in MaizePlus. Highlighted feed types cover more animal groups.

Feed types	Pigs	Cows	Sheep	Horses	Chicken	Chosen
GRASS_WINDROW	**x**	**x**	**x**	**x**		**Fresh**
CLOVER_WINDROW	x	x	x			
CHOPPEDMAIZE	x	x	x			
CHOPPEDMAIZE_FERMENTED		x				
GRASS_FERMENTED		**x**	**x**	**x**		**Silage 1**
SILAGE		x				
CLOVER_FERMENTED		**x**	**x**			**Silage 2**
ALFALFA_FERMENTED		x				
DRYGRASS_WINDROW		**x**	**x**	**x**		**Hay**
DRYALFALFA_WINDROW		x	x	x		
DRYCLOVER_WINDROW		x	x			
OAT				**x**		**Grain 2**
WHEAT	**x**				**x**	**Grain 1**
MAIZE	x				x	
BARLEY	x				x	
SOYBEAN	**x**				**x**	**Protein**
CANOLA	x					
SUNFLOWER	x					
POTATO	x					
SUGARBEET	**x**		**x**		**x**	**Earth 1**
CARROT	**x**		**x**	**x**	**x**	**Earth 2**

Having decided what crops we need and decided how many hectares we want of each crop (Table 71), we can add up how much field work needs to be done (Table 72). The latter table can help us figure out the break-even level for our equipment.

It is evident that we need to lease equipment both for planting and harvesting potatoes. The break-even for a 9-meter manure spreader is 21 ha. We can perhaps afford a bigger one and still justify owning it. On the other hand, we may not have enough manure, time and energy for 80 ha of manure spreading. The break-even for a 4.5-meter planter is 95 ha. So we will be better off leasing a planter. The break-even for a 12-meter lime spreader is above 200 ha. We will lease a lime spreader. The break-even for all harvesters are above the hectares we have. So all harvesters should be leased. We can just justify owning a 4.3-meter mower but should lease tedder and windrower. We can justify owning a baler.

Table 71. Example of chosen crops and how many hectares of each. Sell-crops are in bold font.

ALFALFA	=	2.2000	ha
BARLEY	=	7.7000	ha
CABBAGE	**=**	**5.1000**	**ha**
CANOLA	=	0.0000	ha
CARROT	=	0.8000	ha
CLOVER	=	4.5000	ha
COFFEE	=	0.0000	ha
COTTON	=	0.0000	ha
GRASS	=	3.9000	ha
HEMP	=	0.5000	ha
HOPS	**=**	**3.5000**	**ha**
LETTUCE	**=**	**5.9000**	**ha**
MAIZE	=	10.5000	ha
MILLET	=	0.0000	ha
MUSTARD	**=**	**2.1000**	**ha**
OAT	=	0.0000	ha
OILSEEDRADISH	=	0.0000	ha
ONION	**=**	**4.8000**	**ha**
POPLAR	=	0.0000	ha
POPPY	=	0.0000	ha
POTATO	**=**	**2.4000**	**ha**
REDCABBAGE	**=**	**4.7000**	**ha**
RICE	=	0.0000	ha
RYE	=	1.2000	ha
SOYBEAN	=	6.9000	ha
SUGARBEET	=	0.9000	ha
SUGARCANE	=	0.0000	ha
SUNFLOWER	**=**	**8.8000**	**ha**
TOBACCO	=	0.0000	ha
WHEAT	=	7.7000	ha

Table 72. Field work to be done.

manure	=	80.1000	ha
slurry	=	0.0000	ha
lime	=	28.0333	ha
plow	=	80.1000	ha
subsoil	=	0.0000	ha
tineharrow	=	84.9000	ha
discharrow	=	0.0000	ha
powerharrow	=	0.0000	ha
seed	=	39.7000	ha
plant	=	42.8000	ha
potatoplant	=	2.4000	ha
solidfertilizer	=	88.1000	ha
liquidfertilizer	=	84.1000	ha
spraychemicals	=	84.1000	ha
rolling	=	84.9000	ha
mechanicalweeding	=	0.0000	ha
cerealharvest	=	26.1000	ha
rowharvest	=	19.3000	ha
beetharvest	=	26.5000	ha
potatoharvest	=	2.4000	ha
forageharvest	=	0.0000	ha
mowing	=	31.8000	ha
windrow	=	31.8000	ha
tedding	=	20.1000	ha
bale	=	48.4000	ha
balewrap	=	11.7000	ha
balecollect	=	48.4000	ha
Total crop area	=	84.1000	ha

17 Planning a farm

We will use the forecasting information to plan a farming operation. As an example, we will use the map **Griffin Indiana 19 by ajFarmer** and use US Heartland parameters. The aim is to obtain a farm, where the number of animals and the amount of land is in balance. Planning is the challenge here, not how to get the money for the animals and land.

First, we decide on the size of our animal herds. The number of animals will grow as offspring are born. Look up the pen capacities before deciding on the number of animals. The pens need to hold both the mature animals and the offspring, unless you move the offspring to different pens as they are born. Usually done with calves and 30 days old piglets.

Table 73. Base number of farm animals

Animal type	Number
Pigs	12 mature Yorkshire sows
Cows	40 Holsteins + 20 Limousine
Sheep	80 mature yews
Horses	16

17.1 Prediction of feed need

For each animal type the numbers of mature animals are entered into the respective tables in the script **RealNumbersAnnualFeedPrediction**. Here we have 40 dairy cows and 20 Limosines.

Table 74. Entries for number of mature cows.

```
RNS.cowsl.color              = {   "BROWN",     "BROWN_WHITE",   "BLACK",    "BLACK_WHITE"  };
RNS.cowsl.type               = {  "Limousin",    "Ayrshire",     "Saler",     "Holstein"    };
RNS.cowsl.matureWeight       = {    1000,          540,           1000,         680         };
RNS.cowsl.weightDay          = {     365,          365,            365,         365         };
RNS.cowsl.weightM            = {     566,          480,            516,         495         };
RNS.cowsl.weightF            = {     420,          300,            396,         309         };
RNS.cowsl.linGrowthPct       = {      85,           85,             85,          85         };
RNS.cowsl.monthsToLevelOut   = {      24,           24,             24,          24         };
RNS.cowsl.slaughterAge       = {     365,          365,            365,         365         };
RNS.cowsl.numberMature       = {      20,            0,              0,          40         };
RNS.cowsl.strawPercentage    = {      25,           25,             25,          25         };
RNS.cowsl.hayPercentage      = {      50,           50,             50,          50         };
RNS.cowsl.silagePercentage   = {      25,           25,             25,          25         };
RNS.cowsl.roundBaleVolume    = {    1500,         1500,           1500,        1500         };
RNS.cowsl.squareBaleVolume   = {    2600,         2600,           2600,        2600         };
```

The same is done with the other animal types. Pressing lAlt-ra will print an estimate of each feed type. Table 75 lists the hectares needed for each feed type. However, as shown in Table 70, we only need one feed type within each feed groups. The chosen feed types are highlighted in bold fonts.

Table 75. Predicted feed crop hectares.

```
CANOLA                    =     23.7587  ha
MAIZE                     =      4.6852  ha
DRYALFALFA_WINDROW        =      3.3556  ha
SUGARBEET                 =      1.0903  ha
WHEAT                     =     12.2932  ha
GRASS_FERMENTED           =      2.8336  ha
CLOVER_WINDROW            =      2.7019  ha
CLOVER_FERMENTED          =      2.0250  ha
DRYCLOVER_WINDROW         =      2.3280  ha
SOYBEAN                   =     13.9051  ha
POTATO                    =      1.0227  ha
SILAGE                    =      2.2203  ha
SUNFLOWER                 =     16.1497  ha
BARLEY                    =     12.2412  ha
ALFALFA_FERMENTED         =      1.7917  ha
GRASS_WINDROW             =      2.5111  ha
DRYGRASS_WINDROW          =      2.1382  ha
```

The feed crop hectares needed are summarized in Table 76.

Table 76. Feed crop hectares required.

Feed crop	Hectares
Soybean	14
Wheat	12.5
Grass, silage	2.9
Grass, fresh	2.6
Grass, hay	2.2
Sugarbeet	1.1

The pigs require the most feed crop hectares. The 12 sows will produce about 360 pigs per year. All the feed required by the pigs must be grown and delivered to the feed trough. For dairy cows and sheep it is assumed as a default that 90% of their feed intake is by grazing. For non-dairy cows this fraction is 95%. If all feed for cows and sheep were to be grown and delivered to the feed trough, about 10 times more hectares would be required to grow forage type feed. The user can change the trough fraction of feed.

17.2 Choice of fields.

Pressing lAlt-rf, we can get a list of fields, their sizes and whether they are for sale or rent. From this list we pick fields with the proper size for a given crop. With the Seasons mod, we could also look at crop rotation as a factor when deciding for the fields to use. Table 77 lists the chosen fields without taking crop rotation into account.

Table 77. List of fields chosen for the feed crops.

Feed crop	Hectares	Fields
Soybean	14	18
Wheat	12.5	24+30
Grass, silage	2.9	34
Grass, fresh	2.6	20
Grass, hay	2.2	14
Sugarbeet	1.1	28

Figure 24. Fields rented on the map Griffin Indiana 19 by ajFarmer.

Pressing lAlt-rg we can get a list of the owned and rented fields (Table 78). This is early spring, before any field work. Hence the crops listed are last year's crop.

Table 78. List of fields owned and rented.

```
    Map                    : Griffin Indiana 19 Savegame 7
    Money                  : 205745
    Economic difficulty    : 3
    Sell price multiplier  : 1
    Buy price multiplier   : 1
    Gamedays per year      : 36
    Current month       : March
    Current game day       : 1
    Time of day            : 12:59

    Mean land purchase price = 11532 €/ha
    Mean land rent price per year = 380.556 €/ha
    Mean land rent price for rest of year  =      317  €/ha
    Fraction of remaining rent year  =   0.8333

    All field rent contracts are automatically terminated on the first day of mid-winter.
    The rent fee decreases gradually in proportion to the remaining numbers of days in the rent year.
    On all of the first day of mid-winter, the rent price is zero, and all attempts to rent land is
 nullified.
    Starting on the next day, you can renew your rent contract or rent another field.
    You can terminate a rent contract at any time by selling the rented field. The sell price
    corresponds to the rent for the remainder of the rent year. You pay only for time in use.

    Field  1: Landarea =  5.4 ha, Fieldarea =  4.5 ha, Price =   62219 €,  Owned   , Fruittype:
    Field 14: Landarea =  3.0 ha, Fieldarea =  2.5 ha, Price =     920 €,  Rented  , Fruittype: GRASS
    Field 18: Landarea = 15.3 ha, Fieldarea = 14.1 ha, Price =    4844 €,  Rented  , Fruittype: SOYBEAN
    Field 20: Landarea =  4.4 ha, Fieldarea =  3.0 ha, Price =    1437 €,  Rented  , Fruittype: GRASS
    Field 24: Landarea =  9.4 ha, Fieldarea =  7.4 ha, Price =    2916 €,  Rented  , Fruittype: BARLEY
    Field 28: Landarea =  3.3 ha, Fieldarea =  1.6 ha, Price =    1073 €,  Rented  , Fruittype: SUNFLOWER
    Field 30: Landarea = 11.8 ha, Fieldarea =  5.8 ha, Price =    3903 €,  Rented  , Fruittype: MAIZE
    Field 34: Landarea =  6.3 ha, Fieldarea =  2.9 ha, Price =    1915 €,  Rented  , Fruittype: GRASS
```

17.3 Defining field work.

When the crops and fields have been chosen, it is time to define the type of field work to be done.

Table 79. Some field work definitions for Soybeans. In RealNumbersInitialization.

```
RN.manureApplications.SOYBEAN          = 1;
RN.slurryApplications.SOYBEAN          = 0;
RN.limeApplications.SOYBEAN            = 1/3;
RN.isPlowing.SOYBEAN                   = 1;
RN.isDirectSeeding.SOYBEAN             = 0;
RN.solidFertApplications.SOYBEAN       = 1;
RN.liquidFertApplications.SOYBEAN      = 0;
RN.fertFirstApplication.SOYBEAN        = "cowMANURE";
RN.fertSecondApplication.SOYBEAN       = "FERTILIZER";
RN.herbicideApplications.SOYBEAN       = 1;
RN.seederType.SOYBEAN                  = "SEEDERS";
RN.harvesterType.SOYBEAN               = "HARVESTERS";
RN.isBaling.SOYBEAN                    = 0;
RN.baleType.SOYBEAN                    = "noBale";
```

The mod Precision Farming works with two fertilizer applications per year. RealLifeNumbers has been adapted to this approach. By default, all arable crops now should have cow manure as the first fertilizer application and solid fertilizer as the second application. The mod user can change this by changing the names of the fertilizer sources.

Data must be consistent. If we change fertilizer strategy, several parameters must be changed.

Table 80. New fertilizer strategy for Soybean.

```
RN.manureApplications.SOYBEAN          = 0;
RN.slurryApplications.SOYBEAN          = 1;
RN.limeApplications.SOYBEAN            = 1/3;
RN.isPlowing.SOYBEAN                   = 1;
RN.isDirectSeeding.SOYBEAN             = 0;
RN.solidFertApplications.SOYBEAN       = 0;
RN.liquidFertApplications.SOYBEAN      = 1;
RN.fertFirstApplication.SOYBEAN        = "cowLIQUIDMANURE";
RN.fertSecondApplication.SOYBEAN       = "LIQUIDFERTILIZER";
RN.herbicideApplications.SOYBEAN       = 1;
RN.seederType.SOYBEAN                  = "SEEDERS";
RN.harvesterType.SOYBEAN               = "HARVESTERS";
RN.isBaling.SOYBEAN                    = 0;
RN.baleType.SOYBEAN                    = "noBale";
```

In Table 80, the first fertilizer application is slurry and the second is liquid fertilizer. Notice that several parameters are changed to be consistent. You can also specify if you want to plow, or use direct seeding, and how many applications of herbicides you will do.

In some countries, organic fertilizers are never use, in others they are the primary fertilizer. Most likely you will not have enough organic fertilizer for all your fields. In the log file, we can get estimates of much manure and slurry we will have at the end of the year.

Table 81. Estimate of cow manure and slurry at the end of the year.

		Limousin	Ayrshire	Saler	Holstein	
Number of mature animals	=	20	0	0	40	
Number of offsprings, males	=	0	0	0	4	
Number of offsprings, females	=	0	0	0	36	
Average weight males	=	303	256	277	268	kg
Average weight females	=	230	166	217	175	kg
Average weight gain, males	=	1.4410	1.2263	1.3096	1.2452	kg/day
Average weight gain, females	=	1.0410	0.7332	0.9808	0.7356	kg/day
Slaughter age	=	365	365	365	365	days
Slaughter weight, male	=	566	480	516	495	kg
Slaughter weight, female	=	420	300	396	309	kg
Herd manure per year	=	29930	16162	29930	240697	L/year
Herd slurry per year	=	29200	25623	29200	381593	L/year
Herd bedding straw	=	78615	0	0	314462	L/year
Round straw bales	=	52	0	0	210	Bales/year
Square straw bales	=	30	0	0	121	Bales/year
Water per year	=	657000	0	0	2144572	L/year
Herd feed intake	=	503700	0	0	870444	kg/year
Herd trough feed	=	25185	0	0	87044	kg/year
Feedmix density	=	0.3375	0.3375	0.3375	0.3375	kg/L
Herd Feedmix volume	=	74622	0	0	257909	L/year

Table 81 shows that we will have about 270,000 Liters of manure or 162 Tonne and 410,000 Liters of slurry (369 Tonne). To figure out how much nitrogen this is, we search in the log file for the data in Table 82.

Table 82. NPK content in fertilizers. av = available to the crop.

FERTILIZER	: N = 270.0 kg/Tonne,	P205 = 60.0 kg/Tonne,	K20 = 60.0 kg/Tonne
FERTILIZER crop av.	: N = 216.0 kg/Tonne,	P205 = 48.0 kg/Tonne,	K20 = 54.0 kg/Tonne
LIQUIDFERTILIZER	: N = 270.0 kg/Tonne,	P205 = 60.0 kg/Tonne,	K20 = 60.0 kg/Tonne
LIQUIDFERTILIZER crop av.	: N = 256.5 kg/Tonne,	P205 = 57.0 kg/Tonne,	K20 = 57.0 kg/Tonne
pigLIQUIDMANURE	: N = 3.6 kg/Tonne,	P205 = 1.5 kg/Tonne,	K20 = 2.2 kg/Tonne
pigLIQUIDMANURE crop av.	: N = 2.0 kg/Tonne,	P205 = 0.8 kg/Tonne,	K20 = 2.0 kg/Tonne
cowLIQUIDMANURE	: N = 2.6 kg/Tonne,	P205 = 1.2 kg/Tonne,	K20 = 2.5 kg/Tonne
cowLIQUIDMANURE crop av.	: N = 1.0 kg/Tonne,	P205 = 0.7 kg/Tonne,	K20 = 2.3 kg/Tonne
pigMANURE	: N = 7.0 kg/Tonne,	P205 = 6.0 kg/Tonne,	K20 = 8.0 kg/Tonne
pigMANURE crop av.	: N = 1.1 kg/Tonne,	P205 = 3.6 kg/Tonne,	K20 = 7.2 kg/Tonne
cowMANURE	: N = 6.0 kg/Tonne,	P205 = 3.2 kg/Tonne,	K20 = 9.4 kg/Tonne
cowMANURE crop av.	: N = 0.6 kg/Tonne,	P205 = 1.9 kg/Tonne,	K20 = 8.5 kg/Tonne
DIGESTATE	: N = 4.9 kg/Tonne,	P205 = 1.1 kg/Tonne,	K20 = 3.5 kg/Tonne
DIGESTATE crop av.	: N = 2.7 kg/Tonne,	P205 = 0.7 kg/Tonne,	K20 = 3.1 kg/Tonne
COMPOST	: N = 9.0 kg/Tonne,	P205 = 5.5 kg/Tonne,	K20 = 6.5 kg/Tonne
COMPOST crop av.	: N = 5.0 kg/Tonne,	P205 = 3.3 kg/Tonne,	K20 = 5.9 kg/Tonne

Table 83. Estimates of fertilizer needs and costs per hectare.

			N	P	K	€/Ha
GRASS	annual need	kg/Ha	170.0	23.0	70.0	
cowLIQUIDMANURE	Available NPK	kg/Tonne	1.0	0.7	2.3	
cowLIQUIDMANURE	Spray rate	Tonne/Ha	163.5	31.9	31.1	
cowLIQUIDMANURE	Minimum Spray rate	Tonne/Ha	31.1	31.1	31.1	
cowLIQUIDMANURE	1st application	kg/Ha	32.4	22.4	70.0	124.4
LIQUIDFERTILIZER	2nd application	kg/Ha	137.6	0.6	0.0	92.6
GRASS	Total fertilizer supply cost per ha					217.1
			N	P	K	€/Ha
SOYBEAN	annual need	kg/Ha	0.0	45.0	0.0	
cowMANURE	Available NPK	kg/Tonne	0.6	1.9	8.5	
cowMANURE	Spray rate	Tonne/Ha	0.0	23.4	0.0	
cowMANURE	Minimum Spray rate	Tonne/Ha	0.0	0.0	0.0	
cowMANURE	1st application	kg/Ha	0.0	0.0	0.0	0.0
FERTILIZER	2nd application	kg/Ha	0.0	45.0	0.0	31.9
SOYBEAN	Total fertilizer supply cost per ha					31.9
			N	P	K	€/Ha
SUGARBEET	annual need	kg/Ha	209.0	41.0	299.0	
cowMANURE	Available NPK	kg/Tonne	0.6	1.9	8.5	
cowMANURE	Spray rate	Tonne/Ha	348.3	21.4	35.3	
cowMANURE	Minimum Spray rate	Tonne/Ha	21.4	21.4	21.4	
cowMANURE	1st application	kg/Ha	12.8	41.0	180.7	85.4
FERTILIZER	2nd application	kg/Ha	196.2	0.0	118.3	200.1
SUGARBEET	Total fertilizer supply cost per ha					285.5
			N	P	K	€/Ha
WHEAT	annual need	kg/Ha	209.0	24.0	70.0	
cowMANURE	Available NPK	kg/Tonne	0.6	1.9	8.5	
cowMANURE	Spray rate	Tonne/Ha	348.3	12.5	8.3	
cowMANURE	Minimum Spray rate	Tonne/Ha	8.3	8.3	8.3	
cowMANURE	1st application	kg/Ha	5.0	15.9	70.0	33.1
FERTILIZER	2nd application	kg/Ha	204.0	8.1	0.0	142.5
WHEAT	Total fertilizer supply cost per ha					175.6

For cow manure we would have $0.6\frac{kg}{Tonne} \times 162\ Tonnes = 97.2\ kg$ of nitrogen available to the crop. This is enough for only 0.5 hectares if all the nitrogen should come from cow manure. That would normally not be the case. The second application is supposed to cover the gap between what has already been applied and the total need. Therefore, the NPK ratio of the second application will depend on both the crop type and the type of fertilizer used in the first application. In version 1.2.3.9 we can get estimates of fertilizer costs for each crop. Table 83 shows the fertilizer data for different crop types. For grass type crops the default first fertilizer is slurry and the second is liquid fertilizer, just to have some variety and of course to use up some slurry. As the table shows, the script determines the application rate that will cover all the needs for either N, P, or K. For cow slurry on grass, potassium needs (K) are covered completely in the first application. The second application is then to be a liquid fertilizer with an NPK ratio of 13.7:0.06:0. In real life you would have to choose a ratio available at your fertilizer supplier.

Table 84. Field work specifications. RealNumbersMyFieldCrops.

```
RN.myFieldCrops["SOYBEAN"] = {};
RN.myFieldCrops["SOYBEAN"]["fields"]                  = {};
RN.myFieldCrops["SOYBEAN"]["myFieldArea"]             = {};
RN.myFieldCrops["SOYBEAN"]["totalArea"]               = 0;
RN.myFieldCrops["SOYBEAN"]["fruitName"]               = "SOYBEAN";
RN.myFieldCrops["SOYBEAN"]["fields"]                  = {18};
RN.myFieldCrops["SOYBEAN"]["myFieldArea"]             = {14.1};
RN.myFieldCrops["SOYBEAN"]["manure"]                  = RN.manureAppli
RN.myFieldCrops["SOYBEAN"]["slurry"]                  = RN.slurryAppli
RN.myFieldCrops["SOYBEAN"]["lime"]                    = RN.limeApplica
RN.myFieldCrops["SOYBEAN"]["plow"]                    = 1 * RN.isPlowi
RN.myFieldCrops["SOYBEAN"]["subsoil"]                 = 0 * RN.isPlowi
RN.myFieldCrops["SOYBEAN"]["tineharrow"]              = 1 * (1- RN.isI
RN.myFieldCrops["SOYBEAN"]["discharrow"]              = 0 * (1- RN.isI
RN.myFieldCrops["SOYBEAN"]["powerharrow"]             = 0 * (1- RN.isI
RN.myFieldCrops["SOYBEAN"]["seed"]                    = 1;
RN.myFieldCrops["SOYBEAN"]["plant"]                   = 0;
RN.myFieldCrops["SOYBEAN"]["potatoplant"]             = 0;
RN.myFieldCrops["SOYBEAN"]["solidfertilizer"]         = RN.solidFertAp
RN.myFieldCrops["SOYBEAN"]["liquidfertilizer"]        = RN.liquidFertA
RN.myFieldCrops["SOYBEAN"]["spraychemicals"]          = RN.herbicideAp
RN.myFieldCrops["SOYBEAN"]["rolling"]                 = 1 * (1- RN.isI
RN.myFieldCrops["SOYBEAN"]["mechanicalweeding"]       = 0;
RN.myFieldCrops["SOYBEAN"]["cerealharvest"]           = 1;
RN.myFieldCrops["SOYBEAN"]["rowharvest"]              = 0;
RN.myFieldCrops["SOYBEAN"]["beetharvest"]             = 0;
RN.myFieldCrops["SOYBEAN"]["potatoharvest"]           = 0;
RN.myFieldCrops["SOYBEAN"]["forageharvest"]           = 0;
RN.myFieldCrops["SOYBEAN"]["mowing"]                  = 0;
RN.myFieldCrops["SOYBEAN"]["windrow"]                 = 0;
RN.myFieldCrops["SOYBEAN"]["tedding"]                 = 0;
RN.myFieldCrops["SOYBEAN"]["bale"]                    = 0;
RN.myFieldCrops["SOYBEAN"]["balewrap"]                = 0;
RN.myFieldCrops["SOYBEAN"]["balecollect"]             = 0;
```

For the soybeans we see that application of cow manure is a waste. A single application of a phosphate source would be sufficient. In many areas, potassium might also be needed.

For sugarbeet, the manure application covers all the phosphate, and the second application should have an NPK ratio of 19.6:0:11.8. By playing around with the fertilizer types, one may find the cheapest strategy for each crop. It is clear, that we now are in the need of a mod that allows us to buy NPK fertilizers at different ratios.

To set up a cost of production estimate, we need more information about field work than just fertilizer application.

Table 84 shows a screen shot of a table in the script **RealNumbersMyFieldCrops**. We see that in the case of soybeans, seeding is done one time a year, so is rolling and combine harvesting.

Table 85. Field work for grass.

```
RN.myFieldCrops["GRASS"] = {};
RN.myFieldCrops["GRASS"]["fields"]                 = {};
RN.myFieldCrops["GRASS"]["myFieldArea"]            = {};
RN.myFieldCrops["GRASS"]["totalArea"]              = 0;          --
RN.myFieldCrops["GRASS"]["fruitName"]              = "GRASS";
RN.myFieldCrops["GRASS"]["fields"]                 = {14, 20, 34};
RN.myFieldCrops["GRASS"]["myFieldArea"]            = {2.5, 3.0, 2.9};
RN.myFieldCrops["GRASS"]["manure"]                 = RN.manureApplicat
RN.myFieldCrops["GRASS"]["slurry"]                 = RN.slurryApplicat
RN.myFieldCrops["GRASS"]["lime"]                   = RN.limeApplicatic
RN.myFieldCrops["GRASS"]["plow"]                   = 1 * RN.isPlowing|
RN.myFieldCrops["GRASS"]["subsoil"]                = 0 * RN.isPlowing|
RN.myFieldCrops["GRASS"]["tineharrow"]             = 1 * (1- RN.isDire
RN.myFieldCrops["GRASS"]["discharrow"]             = 0 * (1- RN.isDire
RN.myFieldCrops["GRASS"]["powerharrow"]            = 0 * (1- RN.isDire
RN.myFieldCrops["GRASS"]["seed"]                   = 1;          --
RN.myFieldCrops["GRASS"]["plant"]                  = 0;          --
RN.myFieldCrops["GRASS"]["potatoplant"]            = 0;          --
RN.myFieldCrops["GRASS"]["solidfertilizer"]        = RN.solidFertAppli
RN.myFieldCrops["GRASS"]["liquidfertilizer"]       = RN.liquidFertAppl
RN.myFieldCrops["GRASS"]["spraychemicals"]         = RN.herbicideAppli
RN.myFieldCrops["GRASS"]["rolling"]                = 1 * (1- RN.isDire
RN.myFieldCrops["GRASS"]["mechanicalweeding"]      = 0;          --
RN.myFieldCrops["GRASS"]["cerealharvest"]          = 0;          --
RN.myFieldCrops["GRASS"]["rowharvest"]             = 0;          --
RN.myFieldCrops["GRASS"]["beetharvest"]            = 0;          --
RN.myFieldCrops["GRASS"]["potatoharvest"]          = 0;          --
RN.myFieldCrops["GRASS"]["forageharvest"]          = 0;          --
RN.myFieldCrops["GRASS"]["mowing"]                 = 3;          --
RN.myFieldCrops["GRASS"]["windrow"]                = 3;          --
RN.myFieldCrops["GRASS"]["tedding"]                = 3;          --
RN.myFieldCrops["GRASS"]["bale"]                   = 2;          --
RN.myFieldCrops["GRASS"]["balewrap"]               = 1;          --
RN.myFieldCrops["GRASS"]["balecollect"]            = 2;          --
RN.myFieldCrops["GRASS"]["HAY"]                    = 1;          --
RN.myFieldCrops["GRASS"]["SILAGE"]                 = 1;          --
```

Table 85 shows the field work for grass. Here we need to compromise because all grass fields are treated equally. So rather than taking hay three times from the same field, we take hay from all three fields only once. Another time it is fresh grass and another time it is silage. For silage, we need to mow, windrow, bale, wrap and collect. For hay we need to ted three times rather than wrapping. For fresh grass, we mow and windrow. Pick-up of fresh grass has not been included yet.

Many maps have additional grass types; hence one grass type can be the source of hay, another the source of silage and a third type the source of fresh grass.

Table 86. Field work for wheat.

```
RN.myFieldCrops["WHEAT"] = {};
RN.myFieldCrops["WHEAT"]["fields"]                        = {};
RN.myFieldCrops["WHEAT"]["myFieldArea"]                   = {};
RN.myFieldCrops["WHEAT"]["totalArea"]                     = 0;
RN.myFieldCrops["WHEAT"]["fruitName"]                     = "WHEAT";
RN.myFieldCrops["WHEAT"]["fields"]                        = {24, 30};
RN.myFieldCrops["WHEAT"]["myFieldArea"]                   = {7.4, 5.8};
RN.myFieldCrops["WHEAT"]["manure"]                        = RN.manureApp
RN.myFieldCrops["WHEAT"]["slurry"]                        = RN.slurryApp
RN.myFieldCrops["WHEAT"]["lime"]                          = RN.limeAppl:
RN.myFieldCrops["WHEAT"]["plow"]                          = 1 * RN.isPl
RN.myFieldCrops["WHEAT"]["subsoil"]                       = 0 * RN.isPl
RN.myFieldCrops["WHEAT"]["tineharrow"]                    = 1 * (1- RN.:
RN.myFieldCrops["WHEAT"]["discharrow"]                    = 0 * (1- RN.:
RN.myFieldCrops["WHEAT"]["powerharrow"]                   = 0 * (1- RN.:
RN.myFieldCrops["WHEAT"]["seed"]                          = 1;
RN.myFieldCrops["WHEAT"]["plant"]                         = 0;
RN.myFieldCrops["WHEAT"]["potatoplant"]                   = 0;
RN.myFieldCrops["WHEAT"]["solidfertilizer"]               = RN.solidFert
RN.myFieldCrops["WHEAT"]["liquidfertilizer"]              = RN.liquidFe:
RN.myFieldCrops["WHEAT"]["spraychemicals"]                = RN.herbicide
RN.myFieldCrops["WHEAT"]["rolling"]                       = 1 * (1- RN.:
RN.myFieldCrops["WHEAT"]["mechanicalweeding"]             = 0;
RN.myFieldCrops["WHEAT"]["cerealharvest"]                 = 1;
RN.myFieldCrops["WHEAT"]["rowharvest"]                    = 0;
RN.myFieldCrops["WHEAT"]["beetharvest"]                   = 0;
RN.myFieldCrops["WHEAT"]["potatoharvest"]                 = 0;
RN.myFieldCrops["WHEAT"]["forageharvest"]                 = 0;
RN.myFieldCrops["WHEAT"]["mowing"]                        = 0;
RN.myFieldCrops["WHEAT"]["windrow"]                       = 0;
RN.myFieldCrops["WHEAT"]["tedding"]                       = 0;
RN.myFieldCrops["WHEAT"]["bale"]                          = 1;
RN.myFieldCrops["WHEAT"]["balewrap"]                      = 0;
RN.myFieldCrops["WHEAT"]["balecollect"]                   = 1;
```

For wheat we need to plow, seed, roll, fertilize, spray herbicide, combine, bale and collect. If the wheat fields were 10 times larger, one would probably just do direct seeding, fertilize, spray herbicide and combining and no more.

We now have set up all we need to get an overview of the fieldwork to be done. Table 87 shows the hectares for each crop and Table 88 shows the hectares to be worked for each type of field work.

Table 87. Crop area.

BARLEY	=	0.0000	ha
CANOLA	=	0.0000	ha
COTTON	=	0.0000	ha
GRASS	=	8.4000	ha
MAIZE	=	0.0000	ha
OAT	=	3.9000	ha
OILSEEDRADISH	=	0.0000	ha
POPLAR	=	0.0000	ha
POTATO	=	0.0000	ha
SOYBEAN	=	14.1000	ha
SUGARBEET	=	1.6000	ha
SUGARCANE	=	0.0000	ha
SUNFLOWER	=	0.0000	ha
WHEAT	=	13.2000	ha

Table 88. Field work in hectares.

manure	=	18.7000	ha
slurry	=	22.5000	ha
lime	=	13.7333	ha
plow	=	41.2000	ha
subsoil	=	0.0000	ha
tineharrow	=	41.2000	ha
discharrow	=	0.0000	ha
powerharrow	=	0.0000	ha
seed	=	39.6000	ha
plant	=	1.6000	ha
potatoplant	=	0.0000	ha
solidfertilizer	=	18.7000	ha
liquidfertilizer	=	22.5000	ha
spraychemicals	=	41.2000	ha
rolling	=	41.2000	ha
mechanicalweeding	=	0.0000	ha
cerealharvest	=	31.2000	ha
rowharvest	=	0.0000	ha
beetharvest	=	1.6000	ha
potatoharvest	=	0.0000	ha
forageharvest	=	0.0000	ha
mowing	=	25.2000	ha
windrow	=	25.2000	ha
tedding	=	25.2000	ha
bale	=	33.9000	ha
balewrap	=	8.4000	ha
balecollect	=	33.9000	ha
Total crop area	=	41.2000	ha

17.4 Equipment needs.

Now that we know how much field work needs to be done, we can figure out the cost of equipment and compare these costs for different sizes of equipment and whether we own the equipment or make a short-term lease.

We need to edit the entries in the script **RealNumbersEquipmentEconomy**.

Table 89. Parameters for estimating equipment cost. RealNumbersEquipmentEconomy.

```
RN.equipment.price["DISCHARROWS"]                = RN.usedEquipmentPriceScaling * 18000; --  €
RN.equipment.loanTime["DISCHARROWS"]             = RN.loanYears;    -- years
RN.equipment.lifeTime["DISCHARROWS"]             = 20;    -- years
RN.equipment.depreciationRate["DISCHARROWS"]     = 0.1;
RN.equipment.width["DISCHARROWS"]                = 3;    -- m
RN.equipment.speed["DISCHARROWS"]                = 10;   -- kph
RN.equipment.efficiency["DISCHARROWS"]           = 0.83;
RN.equipment.workArea["DISCHARROWS"]             = RN.fieldArea["DISCHARROWS"];
RN.equipment.neededHP["DISCHARROWS"]             = 100;  -- hp
RN.equipment.fuelPerHourPerHP["DISCHARROWS"]     = RN.fuelPerHourPerHP;
RN.equipment.isLeasing["DISCHARROWS"]            = false;
```

Typical parameters to change are equipment width, work speed, horse-power need, and whether the equipment should be leased. In Table 89, the disc harrow is owned. Fuel and lubrication costs are determined by the horse-power need of the implement, not the size of the tractor.

In the log file, expense data is presented for many types of equipment. Table 90 shows a fraction of this data. Expenses are split into fixed costs (financing) and operations cost (repairs, fuel, lubrication, labor). For the manure spreader the cost per hectare is 109 € if you own the spreader, 16 € if you lease the spreader, and 130 € if you hire a contractor. The **break-even hectare** shows the minimum worked hectares to favor ownership over hiring a contractor. In this case 16 ha. Here the manure spreader is to be used on 18.7 ha, so the cost of ownership is just slightly below the cost of hiring a contractor.

Leasing is a lot cheaper than owning the equipment. With only 41 hectares to farm, owning equipment is not a smart choice.

Notice that for the Disc harrow it says 25 ha off worked land. Because we are not using a disc harrow, the default setting is used. The script is a tool for prediction as much as a tool for calculating actual costs. Hence you can use the script to investigate the costs of different implements without owning it.

If you want accurate estimates of the cost of operations for your current operation, you need to enter the specifications for the implements you actually use.

Table 90. Costs of some equipment.

			MANURESPREADER	SLURRYTANKS	PLOWS	DISCHARROWS
Price	: €	:	19800	16560	10080	12960
Loan duration	: years	:	7	7	7	7
Life time	: years	:	20	20	20	20
Net interest rate	: %	:	2.0000	2.0000	2.0000	2.0000
Interest cost	: €	:	2944	2462	1499	1927
Loan cost	: €	:	22744	19022	11579	14887
Depreciation rate per year	: -	:	0.1000	0.1000	0.1000	0.1000
Salvage fraction	: -	:	0.1216	0.1216	0.1216	0.1216
Sell price	: €	:	2407	2013	1225	1576
Loan payment	: €	:	20337	17009	10353	13311
Life time depreciation	: €	:	17393	14547	8855	11384
Investment cost	: €	:	37730	31556	19208	24696
Investment cost per year	: €/year	:	1886	1578	960	1235
Tax, insurance, housing cost	: €/year	:	11	9	6	7
Fixed cost per year	: €/year	:	1898	1587	966	1242
Implement width	: m	:	9.0000	9.0000	2.5000	3.0000
Implement speed	: kph	:	8.0000	8.0000	12.0000	10.0000
Implement efficiency	: -	:	0.6300	0.6000	0.8500	0.8300
Implement capacity	: ha/hour	:	4.5360	4.3200	2.5500	2.4900
Implement work area	: ha/year	:	18.7000	22.5000	41.2000	25.0000
Implement hours per year	: hours/year	:	4.1226	5.2083	16.1569	10.0402
Implement hours life time	: hours	:	82	104	323	201
Repair factor	: -	:	0.0100	0.0100	0.0100	0.0100
Repairs per year	: €/year	:	10	8	5	6
Repairs per hour	: €/hour	:	2.4014	1.5898	0.3119	0.6454
Required HP	: hp	:	110	85	150	100
Fuel per hour	: L/hour	:	18.3370	14.1695	25.0050	16.6700
Fuel cost per hour	: €/hour	:	14.1447	10.9300	19.2882	12.8588
Lubrication cost per hour	: €/hour	:	2.1217	1.6395	2.8932	1.9288
Labor cost per hour	: €/hour	:	16.5000	16.5000	16.5000	16.5000
Operating cost per hour	: €/hour	:	35.1678	30.6593	38.9934	31.9331
Operating cost per ha	: €/ha	:	7.7530	7.0971	15.2915	12.8245
Fixed cost per ha	: €/ha	:	101.4749	70.5363	23.4476	49.6821
Fixed + op. cost per ha	: €/ha	:	109	78	39	63
Fixed + op. cost per hour	: €/hour	:	495	335	99	156
Fixed + op. cost per year	: €/year	:	2043	1747	1596	1563
Lease cost per ha	: €/ha	:	8.7302	7.6667	7.9059	10.4096
Lease + op. cost per ha	: €/ha	:	16	15	23	23
Lease + op. cost per hour	: €/hour	:	75	64	59	58
Lease + op. cost per year	: €/year	:	308	332	956	581
Contract cost per ha	: €/ha	:	130	130	112	35
Contract cost per hour	: €/hour	:	590	562	286	87
Contract cost per year	: €/year	:	2431	2925	4614	875
Contract - op. cost per ha	: €/ha	:	122	123	97	22
Break-even ha	: ha/year	:	16	13	10	56
Break-even field hours	: hours/year	:	3	3	4	22

A similar script called **RealNumbersBalingEquipmentEconomy** estimates the costs of baling equipment. Table 91 shows that you can set the costs of wrapping, the cost of plastic, the cost of moving/transporting the bales and the cost of stacking them. You can also indicate whether you lease the baler.

Costs of baling is usually estimated as a cost per bale. As we also estimate the number of each bale type per hectare, we can also provide the cost of baling per hectare. The script will add up the different types of bales, assuming that the same baler is used for all bales made on the farm.

Table 91. Estimation of cost of baling equipment.

```
RN.equipment.price["SILAGEROUNDBALE"]                 = RN.usedEquipmentPriceScaling * 76000; --  €
RN.equipment.loanTime["SILAGEROUNDBALE"]              = RN.loanYears;    -- years
RN.equipment.lifeTime["SILAGEROUNDBALE"]              = 20;    -- years
RN.equipment.depreciationRate["SILAGEROUNDBALE"]      = 0.1;
RN.equipment.efficiency["SILAGEROUNDBALE"]            = 0.80;
RN.equipment.workArea["SILAGEROUNDBALE"]              = RN.fieldArea["SILAGEROUNDBALE"];
RN.equipment.neededHP["SILAGEROUNDBALE"]              = 110;  -- hp
RN.equipment.fuelPerHourPerHP["SILAGEROUNDBALE"]      = RN.fuelPerHourPerHP;
RN.equipment.wrappingPerBale["SILAGEROUNDBALE"]       = 7.5;
RN.equipment.plasticPerBale["SILAGEROUNDBALE"]        = 3;
RN.equipment.movingPerBale["SILAGEROUNDBALE"]         = 1;
RN.equipment.stackingPerBale["SILAGEROUNDBALE"]       = 2;
RN.equipment.isLeasing["SILAGEROUNDBALE"]             = false;

RN.equipment.price["SILAGESQUAREBALE"]                = RN.usedEquipmentPriceScaling * 105000; --  €
RN.equipment.loanTime["SILAGESQUAREBALE"]             = RN.loanYears;    -- years
RN.equipment.lifeTime["SILAGESQUAREBALE"]             = 20;    -- years
RN.equipment.depreciationRate["SILAGESQUAREBALE"]     = 0.1;
RN.equipment.efficiency["SILAGESQUAREBALE"]           = 0.80;
RN.equipment.workArea["SILAGESQUAREBALE"]             = RN.fieldArea["SILAGESQUAREBALE"];
RN.equipment.neededHP["SILAGESQUAREBALE"]             = 140;  -- hp
RN.equipment.fuelPerHourPerHP["SILAGESQUAREBALE"]     = RN.fuelPerHourPerHP;
RN.equipment.wrappingPerBale["SILAGESQUAREBALE"]      = 7.5;
RN.equipment.plasticPerBale["SILAGESQUAREBALE"]       = 3;
RN.equipment.movingPerBale["SILAGESQUAREBALE"]        = 1;
RN.equipment.stackingPerBale["SILAGESQUAREBALE"]      = 2;
RN.equipment.isLeasing["SILAGESQUAREBALE"]            = false;

RN.equipment.price["DRYGRASSROUNDBALE"]               = RN.usedEquipmentPriceScaling * 76000; --  €
RN.equipment.loanTime["DRYGRASSROUNDBALE"]            = RN.loanYears;    -- years
RN.equipment.lifeTime["DRYGRASSROUNDBALE"]            = 20;    -- years
RN.equipment.depreciationRate["DRYGRASSROUNDBALE"]    = 0.1;
RN.equipment.efficiency["DRYGRASSROUNDBALE"]          = 0.80;
RN.equipment.workArea["DRYGRASSROUNDBALE"]            = RN.fieldArea["DRYGRASSROUNDBALE"];
RN.equipment.neededHP["DRYGRASSROUNDBALE"]            = 110;  -- hp
RN.equipment.fuelPerHourPerHP["DRYGRASSROUNDBALE"]    = RN.fuelPerHourPerHP;
RN.equipment.wrappingPerBale["DRYGRASSROUNDBALE"]     = 0;
RN.equipment.plasticPerBale["DRYGRASSROUNDBALE"]      = 0;
RN.equipment.movingPerBale["DRYGRASSROUNDBALE"]       = 1;
RN.equipment.stackingPerBale["DRYGRASSROUNDBALE"]     = 2;
RN.equipment.isLeasing["DRYGRASSROUNDBALE"]           = false;
```

Table 92 compares the costs of baling for round and square bales and for silage, hay, and straw. On a per bale basis, the cost of producing square bales is significantly higher than for round bales. However, the volume of a round bale is set to only 1500 L compared to 2600 Liters for the square bales. Comparing costs on a per hectare basis is therefore easier.

Table 92. Estimated costs of baling.

			SILAGE BALING		DRYGRASS BALING		STRAW BALING	
			Round	Square	Round	Square	Round	Square
Price	: €	:	54720	75600	54720	75600	54720	75600
Loan time	: years	:	7	7	7	7	7	7
Life time	: years	:	20	20	20	20	20	20
Net interest rate	: %	:	2.0000	2.0000	2.0000	2.0000	2.0000	2.0000
Interest cost	: €	:	8136	11241	8136	11241	8136	11241
Loan cost	: €	:	62856	86841	62856	86841	62856	86841
Depreciation rate per year	: -	:	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
Salvage fraction	: -	:	0.1216	0.1216	0.1216	0.1216	0.1216	0.1216
Sell price	: €	:	6653	9191	6653	9191	6653	9191
Loan payment	: €	:	56203	77649	56203	77649	56203	77649
Life time depreciation	: €	:	48067	66409	48067	66409	48067	66409
Investment cost	: €	:	104271	144058	104271	144058	104271	144058
Investment cost per year	: €/year	:	5214	7203	5214	7203	5214	7203
Tax, insurance, housing cost	: €/year	:	31	42	31	42	31	42
Fixed cost per year	: €/year	:	5244	7245	5244	7245	5244	7245
Partial fixed cost per year	: €/year	:	1299	1795	1299	1795	2645	3655
Throughput	: Ton/hour	:	16.0000	16.0000	16.0000	16.0000	16.0000	16.0000
Ton per ha	: Ton/ha	:	21.5190	21.5190	9.2795	9.2795	3.6760	3.6760
Implement efficiency	: -	:	0.8000	0.8000	0.8000	0.8000	0.8000	0.8000
Implement capacity	: ha/hour	:	0.5948	0.5948	1.3794	1.3794	3.4820	3.4820
Implement work area	: ha/year	:	8.4000	8.4000	8.4000	8.4000	17.1000	17.1000
Implement hours per year	: hours/year	:	14.1218	14.1218	6.0897	6.0897	4.9109	4.9109
Implement hours life time	: hours	:	282	282	122	122	98	98
Repair factor	: -	:	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100
Repairs per year	: €/year	:	27	38	27	38	27	38
Repairs per hour	: €/hour	:	1.9374	2.6767	4.4929	6.2072	5.5713	7.6972
Required HP	: hp	:	110	140	110	140	110	140
Fuel per hour	: L/hour	:	18.3370	23.3380	18.3370	23.3380	18.3370	23.3380
Fuel cost per hour	: €/hour	:	14.1447	18.0023	14.1447	18.0023	14.1447	18.0023
Lubrication cost per hour	: €/hour	:	2.1217	2.7004	2.1217	2.7004	2.1217	2.7004
Labor cost per hour	: €/hour	:	16.5000	16.5000	16.5000	16.5000	16.5000	16.5000
Operating cost per hour	: €/hour	:	34.7038	39.8794	37.2593	43.4099	38.3377	44.8999
Operating cost per year	: €/year	:	490.0818	563.1704	226.8962	264.3517	188.2728	220.4990
Operating cost per ha	: €/ha	:	58.3431	67.0441	27.0114	31.4704	11.0101	12.8947
Operating cost per bale	: €/bale	:	1.6584	3.3127	0.8674	1.7567	0.6107	1.2432
Fixed cost per ha	: €/ha	:	154.6968	213.7259	154.6968	213.7259	154.6968	213.7259
Fixed cost per bale	: €/bale	:	4.3973	10.5603	4.9679	11.9306	8.5805	20.6064
Fixed + op. cost per ha	: €/ha	:	213	281	182	245	166	227
Fixed + op. cost per year	: €/year	:	1790	2358	1526	2060	2834	3875
Fixed + op. cost per bale	: €/bale	:	6	14	6	14	9	22
Supply cost per bale	: €/bale	:	11	11	0	0	0	0
Supply cost per ha	: €/ha	:	369	213	0	0	0	0
Operating and supply cost per ha	: €/ha	:	428	280	27	31	11	13
Fixed + op. + supply cost per ha	: €/ha	:	582	493	182	245	166	227
Contract cost per bale	: €/bale	:	19	22	9	11	7	8
Contract cost per ha	: €/ha	:	668	445	280	197	126	83
Contract cost per year	: €/year	:	5615	3740	2354	1655	2158	1419
Break-even fixed cost per ha	: €/ha	:	241	166	253	166	115	70
Break-even ha	: ha/year	:	5	11	5	11	23	52

17.5 Cost of crop production

We have already covered the cost of fertilizer. The cost of seed depends on the seed rate.

The parameters used to determine seed application rate is defined in the fruit type tables in RealNumbersInitialization (Table 93).

Table 93. Seed rate parameters.

```
RN.seedDensity.WHEAT          = 0.772;
RN.TSM.WHEAT                  = 35;
RN.plantsPerSqm.WHEAT         = 250;
RN.germination.WHEAT          = 90;
RN.seedUsagePerSqm.WHEAT      = 0;
RN.seedPricePer100kg.WHEAT    = 52.00;
```

When “seedUsagePerSqm” is set to zero, it will compute this value based on the other parameters (see earlier section). The log file compiles a table of seed application rates (Table 94).

Table 94. Seed application rates and seed pallets needed.

Seed type		Seed rate (L/ha)	Pallet volume (L)	Pallets/ha	Ha/pallet
BARLEY	:	151.02	460	0.328	3.0
CANOLA	:	4.31	20	0.216	4.6
COTTON	:	60.67	90	0.674	1.5
GRASS	:	27.60	90	0.307	3.3
MAIZE	:	38.06	120	0.317	3.2
OAT	:	235.98	710	0.332	3.0
OILSEEDRADISH	:	42.86	130	0.330	3.0
POTATO	:	2400.00	1000	2.400	0.4
SOYBEAN	:	103.63	320	0.324	3.1
SUGARBEET	:	3.74	20	0.187	5.4
SUNFLOWER	:	17.20	60	0.287	3.5
WHEAT	:	125.94	380	0.331	3.0

This table assumes the mod **Realistic Seeder** is used. The pallet volumes are adjusted by RealLifeNumbers to give sufficient seeds for about 3 hectares (rounding effects will cause some variations). The reason for the adjust is that the default pallet volume of 2100 Liters is way too much seed for some crop types. 2100 L of sugarbeet seed is enough for 560 hectares and will cost 102,000 €.

We can now list the estimates of field work cost for each crop type.

Table 95. Field work cost for different crop types. Costs per hectare.

€/Ha		Nat Fert Lime	Plow costs	Cultivate Seed	Fert costs	Herb costs	Harvest costs	Field work Total
BARLEY	: €/Ha	19	39	99	58	34	96	345
CANOLA	: €/Ha	19	39	99	58	34	96	345
COTTON	: €/Ha	19	39	1332	58	34	0	1482
GRASS	: €/Ha	18	39	99	34	34	2318	2450
MAIZE	: €/Ha	19	39	1332	58	34	96	1578
OAT	: €/Ha	19	39	99	58	34	96	345
OILSEEDRADISH	: €/Ha	3	39	99	0	34	0	175
POPLAR	: €/Ha	16	0	63	58	0	0	137
POTATO	: €/Ha	19	39	107	58	34	258	515
SOYBEAN	: €/Ha	18	39	99	34	34	96	320
SUGARBEET	: €/Ha	19	39	1332	58	34	162	1644
SUGARCANE	: €/Ha	19	39	63	58	34	0	213
SUNFLOWER	: €/Ha	19	39	1332	58	34	96	1578
WHEAT	: €/Ha	19	39	99	58	34	96	345

We also need to include income into the Cost of Production estimate. Table 96 shows the numbers for grass. Similar data is available in the log file for all crop types on the map.

Table 96. Income estimates for grass.

```
GRASS
SEED_GRASS
Windrow name : GRASS_WINDROW
GRASS massPerLiter                          =     0.3900  kg/L
Yield randomness scaling                    =     1.0000
GRASS base yield                            =     2.7588  L/sqm
GRASS base yield                            =  27588      L/Ha
GRASS no-plough loss                        =   4138      L/Ha
GRASS no-weeding loss                       =   5518      L/Ha
GRASS liming gain                           =   4138      L/Ha
GRASS 1x fertilizing gain                   =   4598      L/Ha
GRASS max yield                             =  55177      L/Ha
GRASS windrowLiterPerHa                     =  52418      L/Ha
GRASS round bales Per Ha                    =    35.1799  Bales/Ha
GRASS square bales Per Ha                   =    20.2386  Bales/Ha
GRASS seed Mass Per Liter                   =     0.3100  kg/L
GRASS seed Mass Per Ha                      =     8.5556  kg/Ha
GRASS seed Volume Per Ha                    =    27.5986  L/Ha
GRASS seed Cost Per Liter                   =     1.0850 €/L
GRASS seed Cost Per Ha                      =    29.9444 €/Ha
GRASS Lime Cost Per Ha (1/3)                =    27.7667 €/Ha
GRASS NPK Cost Per Ha                       =   217.0922 €/Ha
GRASS Crop protection CostPerHa             =   154.0000 €/Ha
GRASS Supply costs Per Ha                   =   281.6478 €/Ha
GRASS price Per 1000 Liter                  =    25      €/1000 L
GRASS Gross income per ha - no loss         =   1370      €/Ha
GRASS Net income per ha - no loss           =   1089      €/Ha
Supply costs averaged over 5 years for grass, clover and alfalfa
```

The Cost of Production estimates are listed in Table 97.

Table 97. Cost of Production estimates for all crops on the map.

€/Ha		Gross income	Supply costs	Net income	Field work	Field rent	Profit	Feed cost €/1000 L	Feed price €/1000 L
BARLEY	: €/Ha	687	271	416	345	381	-309	103	138
CANOLA	: €/Ha	624	752	-128	345	381	-854	416	284
COTTON	: €/Ha	2041	777	1264	1482	381	-599	409	444
GRASS	: €/Ha	1370	282	1089	2450	381	-1742	50	30
MAIZE	: €/Ha	1623	450	1172	1578	381	-786	130	125
OAT	: €/Ha	503	208	295	345	381	-430	95	104
OILSEEDRADISH	: €/Ha	0	140	-140	175	381	-696	88	0
POPLAR	: €/Ha	1128	416	712	137	381	195	20	48
POTATO	: €/Ha	9195	1187	8008	515	381	7113	33	216
SOYBEAN	: €/Ha	1251	325	927	320	381	227	143	333
SUGARBEET	: €/Ha	932	748	184	1644	381	-1841	47	22
SUGARCANE	: €/Ha	2536	786	1750	213	381	1157	9	26
SUNFLOWER	: €/Ha	712	216	496	1578	381	-1463	462	220
WHEAT	: €/Ha	775	412	363	345	381	-362	127	156

The gross income is the sell-value of the harvested crop. Subtracting the cost of supplies (fertilizer, seed, herbicides), we get the net income. Subtracting the cost of field work and the rent value of the field we get the net profit. For the majority of the crops the profit is negative, primarily because the cost of field work is too high. This all points in the direction of (1) no organic fertilizer, (2) no tillage, (3) no baling.

Although the crops cannot be sold with profit, they can still be cheaper to use as feed. The last two columns on the right-hand side compares the value of the grown crop as feed (Feed cost) to the purchase price (Feed price) of the same feed. It is estimated to be cheaper to grow barley, oat, potato, soybean, and wheat for your own feed need. Potatoes and soybean can be sold for profit. Sugarcane is unclear. The correct estimate for field work cost is not complete for sugarcane.

Maps with multifruits show that vegetable crops are by far the most profitable. However, the profit may be too high because real-life equipment for vegetable farming may be more expensive than a modified beet harvester. Storage and handling cost will also be a lot higher than for grain crops.

As a new feature in 1.2.3.9, RealLifeNumbers now offers Cost of Production estimates per field. Table 98 shows the estimate for field 18 with 14.1 ha of soybeans. The field earnings are estimated to 8570 €. However, a lease of 5372 € must be paid, so the profit is about 3200 €. As work has not yet commenced, the only expense registered by precision Farming is the cost of soil samples. I have edited my copy of Precision Farming so the cost of one soil sample is 15 € on hard level.

Table 98. Cost of Production per field. Comparison with Precision Farming.

```
----------------------------------------------------------------
Field                          =        18
Farmland                       =         7
Farmland Area                  =       15.3364 ha
Field Area                     =       14.1166 ha
Farmland price                 =     4881.8070 €
Fruit name                     =    SOYBEAN
Owner status                   =     Rented

----------------------------------------------------------------

Supply costs

                                         N         P         K
Removed from soil (kg)         =         0       635         0
COWLIQUIDMANURE (kg)           =         0         0         0
LIQUIDFERTILIZER (kg)          =         0       635         0

COWLIQUIDMANURE                =        0.00 To        0.00 €
LIQUIDFERTILIZER               =      529.37 To      451.03 €
Lime (1/3)                     =       23.06 To      391.97 €
Seed - soybean                 =     1129.33 kg     2258.66 €
Herbicide                      =      144.47 kg     1482.25 €

Supply cost                                   =     4583.91 €

----------------------------------------------------------------

Field work costs

Plow cost                                     =      546.87 €
Cultivator cost                               =      882.38 €
Manure spreader cost                          =        0.00 €
Slurry sprayer cost                           =      208.41 €
Lime spreader cost (1/3)                      =       41.57 €
Mineral fertilizer spreader cost              =        0.00 €
Liquid fertilizer sprayer cost                =      482.33 €
Herbicide sprayer cost                        =      482.33 €
Seed drill cost                               =      516.86 €
Combine harvester cost                        =     1350.90 €

Total field work cost                         =     4511.65 €

----------------------------------------------------------------

Crop value
Yield                          =       49.15 To    17666.01 €
No windrow                     =        0.00  L        0.00 €
Total cost                                    =     9095.56 €
Field earnings                                =     8570.45 €
Field rent value                              =     5372.18 €

----------------------------------------------------------------

Precision Farming Data

Soilsamples                    =         142        2130.00 €
Lime                           =        0.00  L        0.00 €
Mineral fertilizer             =        0.00  L        0.00 €
Liquid fertilizer              =        0.00  L        0.00 €
Manure                         =        0.00  L        0.00 €
Slurry                         =        0.00  L        0.00 €
Seeds                          =        0.00  L        0.00 €
Diesel                         =        0.00  L        0.00 €
Vehicle cost                                  =        0.00 €
Helper cost                                   =        0.00 €
----------------------------------------------------------------
Yield                          =        0.00  L        0.00 €

Total cost                                    =     2130.00 €

Earnings                                      =    -2130.00 €
================================================================
```

18 End notes

A lot more could have been done, and things could have been more streamlined with nice HUDs. But better stop at 80%, as the remaining 20% takes 80% of the time. I hope you will enjoy simulating real-life farming, and not the least, tweaking the mod to your game.

Figure 25. The first rain in 120 days.

19 Appendix

Table 99. Pig terminology[5].

Term	Description
Barrow	Male pig castrated before reaching sexual maturity.
Boar	Male hog or pig with intact testicles.
Colostrum	First milk produced by the sow; it provides immunity to the baby pigs for the first few weeks.
Creep Feed	Creep feed is a starter ration for piglets. It is high in protein, usually from sugar and milk proteins for high energy.
Cull sow	Full-grown female sold for slaughter. Usually showing poor physical characteristics that make her undesirable for breeding.
Culling	This is the process of removing any undesirable animals from the herd normally for health or performance issues.
Dam	Mother sow
Estrus	Also known as “going into heat” or “in heat”, is the period when the sow or gilt is sexually receptive. Usually every 21 days, with gilts starting their first estrus between 5 and 8 months depending on the breed of pig.
Farrow	To give birth to piglets. Farrow (as a noun) is a litter.
Farrow to Finish	This means you raise the pig from birth to butchering size.
Feeder Pig	These are young pigs, usually 6 – 10 weeks old that are produced by one farm then purchased and finished on another farm. It also refers to any piglet that is being raised for pork.
Finish Hog	A pig that has been raised to market weight and is ready for butchering.
Finishing	Feeding a pig out to reach market weight.
Gestation	Pregnancy, lasting about 114 days in swine. Also known to some as 3 months, 3 weeks, and 3 days.
Gilt	A gilt or gilts are young females that have not yet produced a litter.
Grower Pig	(Finishing pig)- animal weighing between 40 and 220 lbs. that is being fed for slaughter
Hog	A pig that weighs at least 120 pounds
In Pig	When a sow is pregnant, she is in pig.
Lactation	The time when a sow is producing milk and feeding piglets.
Litter	All the offspring from a single farrowing.
Mummy	A piglet that is born dead but hasn't fully developed. The piglet died too late in the pregnancy for the sow’s body to reabsorb it.
Open	A gilt or sow that did not conceive at breeding or may have absorbed the pregnancy.
Runt	Small or weak pig in a litter. Runts should be culled out of the herd.
Scours	Diarrhea. Severe scours can cause death.
Service	The introduction of semen into the uterus of a sow or gilt. This can be natural (done by a boar) or by artificial insemination.
Shoat	A young pig that has not yet reached 120 pounds.
Sow	Female which has farrowed at least once.
Swine	General term used for all pigs
Wallow	Water-filled depression or container large enough for pigs to lay in to cool off during warm weather
Weaning	Removing young from their mother. Weaning can take place anywhere from 3 to 8 weeks depending on the farmers growing system. Little Pig Farm recommends leaving the piglets to nurse for a minimum of 6 weeks.
Weanling	A piglet recently removed from the sow and typically weighing between 25 and 40 pounds.

[5] http://littlepigfarm.com/swine-terminology/

Table 100. Dairy cow terminology.

Term	Description
Abomasum	True stomach of the ruminant animal.
Beast	General descriptive term for an adult bovine.
Baby beef	Slaughter cattle weighing 700 to 1000lbs (approximately 315 to 450kgs) at 9 to 15 months of age grading good or better for quality.
Beefling	A fat young cattle beast weighing 500kg (approx. 1100lbs) at one and a half to two years of age.
Bobby calf	Calf slaughtered whilst only a few days old.
Bob veal calf	One to three weeks old, sold for baby veal, often the male calves from dairy farms, average weight 150lbs (68kgs).
Body condition score	(BCS) A way for producers to classify their animals, useful in managing feeding of classes of animals.
Bull calf	Male young animal up to stage of yearling.
Bull	Male bovine animal of breeding age, usually over one year old.
Bullock	Mature castrated male cattle destined for meat production.
Bull beef	From entire animals instead of the fatter steer or bullock.
Calf	Bovine animal less than a year old. (In some legislation six months old or even less.
Calving	The act of giving birth in cattle.
Colostrum	First milk following calving. High in fat, protein, and immunoglobulins that may be directly absorbed by the newborn calf in its first 24 hours of life.
Concentrates	The generic term for all non-forage feeds. High energy or high protein feeds consisting primarily of the seed of the plant, but without stems and leaves.
Cow	A female that has had one or more calves.
Cull	To remove a cow from the herd. Culling reasons include voluntary culling of cows for low milk production, or involuntary culling of cows for reasons of health or injury.
Cull cow	A cow that has been removed from the dairy herd or beef breeding herd to be sent to slaughter.
Dairy calf	Calf of a mating between a bull and a cow both of dairy breeds.
Veal calf	Specially reared, grown quickly and fed on special food aged up to three months.
Dairy cow	Cow of a breed specifically defined as being for milk production, as distinct from beef or dual-purpose breeds.
Dam	Mother of a calf.
Dry cow	A cow in the two - three month period between the end of lactation and the subsequent calving. Cows in which calving is imminent are close-up dry cows or are freshening. Also refers to a mature cow that is not lactating whatever the reason.
Fat stock	(Finished Stock) Beef animals that are ready for slaughter.
Flush system	A manure removal system in which an area is cleaned by high volumes of fresh water, or gray water that is recycled from a manure pit or lagoon.
Forage	Feedstuffs composed primarily of the whole plant, including stems and leaves.
Free-Marten	A female born with a male twin, usually infertile.
Fresh (Cow)	A cow who has recently given birth (or “calved”); the act of giving birth (“calving”) is sometimes described as “freshening”
Freestall barn	A type of housing system where cows are housed in large group pens, with free choice access to feed, water, and comfortable stalls to lay in. Stalls in freestall barns are typically bedded with sand, straw, or some type of mattress.
Gray water	Water that is considered waste and not to be used for cleaning milking systems. Usually including recycled water from a lagoon or milk house waste. Even water only used to cool milk in a plate cooler is considered gray water, though it is often fed to cows to reduce total usage.
Hay	Dried feed consisting of the entire plant. Alfalfa, clover, grass, and oat hay are used in dairy rations.

Heifer	Young female bovine animal up to birth of first calf or in lactation following the first calving. May be qualified as replacement (to enter herd as a replacement for a culled cow), pregnant, maiden or spayed heifer. A springing heifer is in the last one or two weeks of pregnancy. After second calving known as a cow (also second calver).
Heifer calf	A baby female cattle.
In Heat	A cow's fertile period when she may become pregnant, indicated by increased activity and other hallmark signs. Most cows cycling normally come into heat every 21 days. This period is also referred to as "estrus."
Lactation	The stage of a cow's life where she is producing milk after having calved. Most cows lactate for between 300 to 365 days before going into a dry period.
Multiparous	Female animal that has had two or more pregnancies resulting in viable offspring.
Maiden heifer	(Bulling Heifer) - heifer before going the bull.
Maiden	A female, e.g. ewe, gilt, heifer, bitch, mare, of breeding age but not yet mated.
Milk solids	What is left when all water is removed from milk. As it comes from the cow, the solids portion of milk contains approximately 3.7 percent fat and 9 percent solids-not-fat. Milk has typically about 4 % fat and 3.5 % protein. This varies between species.
Omasum	Third stomach compartment of ruminant, responsible for removing water and reducing particle size.
Pasture	Plants, such as grass, grown for feeding or grazing animals. Also serves as a place to feed cattle and other livestock.
Protein concentrates	These are intended for further mixing before feeding with planned proportions of cereals and other feedstuffs either on the farm or in a compound mill. They contain blended high-protein ingredients such as MBM, fishmeal and soybean meal. When mixed with appropriate straights (see below), they can be equivalent in nutritional terms to compounds.
Primiparous	General term for any female animal that has had one pregnancy that resulted in viable offspring.
Replacements	Cattle bred on farm to replace culled breeding stock.
Reticulum	First compartment of the ruminant stomach, also called the hardware compartment and honeycomb.
Rotational grazing	Grazing herd rotates between sectioned-off areas of the pasture to allow pasture to regrow. Also called high density grazing, short duration grazing, block and strip grazing, planned grazing and cell grazing. Perennial grass is best.
Ruminant	An animal with a four chambered stomach.
Set stocking	Cows graze continuously in the same pasture over an extended time. Annual grass species, including clovers are favored.
Silage	A feed prepared by chopping green forage (e.g. grass, legumes, field corn) and placing the material in a structure or container designed to exclude air. The material then undergoes fermentation, retarding spoilage. Silage has a water content of between 60 and 80%.
Sire	The father of an animal.
Suckler cow	The mother of a calf raised for beef production.
Stirk	Regional term for a half-grown animal, heifer or bullock, six to 12 months of age.
Steer	Castrated male animal over one year of age.
Stanchion	A method of restraint of dairy cows where their head is restrained.
Stocking ratio	The number of cows per hectare of grazing area open to the cows at any given time.
Store cattle	Animals for beef which have been reared on one or more farms, and then are sold, either to dealers or other farmers. They are brought for finishing, normally well-grown animals of up to two years of age.
Tie-stall barn	A type of housing system where cows remain in an assigned stall for most of the time, with free choice access to food and water. Cows in tie-stalls (also called "stanchion barns") are milked in their stalls (rather than walking to a milking parlor), and typically turned out to exercise for a portion of the day.
Total Mixed Ration (TMR)	Ration formulated to meet requirements of the cow in which all of the ingredients are blended together in a mixer.
Udder	The organ responsible for milk production.
Yearling	An animal in its second year of age, eg yearling cattle, yearling filly, yearling colt.
Young bulls	Male calves that have not been castrated.

Table 101. Milestones in the life of a cow.

Age	Milestone
1-6 hr	Intake of colostrum, the first cow milk rich in antibodies. Ability to absorb these antibodies declines rapidly and is much reduced after 10 hr. Antibodies must reach intestinal walls before bacteria for the calf to survive.
Day 2	Start of milk replacer feeding, removed from dam. Surplus and frozen colostrum may still be used as calf feed.
Day 11	Initial serving of grain starter mix. Solid feed stimulates development of the rumen. Small amounts of long hay (unchopped hay). No silage.
Day 17	Intake of water starts
Day 36	Initial feed of forage
Week 3-5	Goes from two to one daily milk replacer feed.
Week 6-8	Weaning from milk replacer when a minimum grain starter mix of about 1.5 kg is consumed 3 days in a row.
Month 3	Gradual change from starter to grower grain mix.
Month 4	Pasture grazing starts
Month 6	Transition from weaner to grower. Half the hay (dry matter) can be replaced by equivalent amount of silage
Month 12	Transition from grower to finisher
Month 15	Start of first pregnancy
Year 2	First calving
Year 6	Sold for slaughter and replaced by two-year old heifer

A.J. Heinrichs and C.M. Jones have written a very informative paper on feeding the newborn calf[6]. Additional good readings are listed in the footnotes[7,8,9].

[6] https://extension.psu.edu/feeding-the-newborn-dairy-calf
[7] https://www.aphis.usda.gov/animal_health/nahms/dairy/downloads/bamn/BAMN17_GuideFeeding.pdf
[8] https://www.dairynz.co.nz/media/5787669/dairynz-facts-and-figures.pdf
[9] http://www.aces.edu/pubs/docs/A/ANR-0609/ANR-0609.pdf