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# EPOS Innovative teaching tools

**Student group work for the elaboration of a [crop rotation](#) in accordance to the nutritional and phytosanitary needs of a 10 ha area of a market garden as a contractor for vegetable supply**

Students will achieve an understanding for the organisation of a rotational system (a) in the context of a delivery scheme, (b) with regard to plant nutrition and plant protection issues. This excel-based task can be organised as individual module or become part of a module for the planning of a conversion of a vegetable farm

Student group work:

Rotational planning, nutritional management in organic vegetable production

**Market gardens in different regions of your country**  
(soil & climatic conditions should differ)

Delivery contracts for farms with a production area of 10 ha

Quantities of vegetables to be delivered over the growing season

Include 20 % of green manure, blooming stripes and area of spreadable plant-based fertilizers

Note 1:

The following example of a list of annual delivery is originated from German circumstances, but it can be adjusted to other conditions at any time.

Note 2:

The used database for nutrient contents of vegetables is part of the N-Expert® programme provided by IGZEV (Leibniz-Institute of Vegetable and Ornamental Crops). German names are translated. The excel data-transfer from one sheet to another is operating by numeric figures. This table can be exchanged by similar lists which better reflects the nutritious status of crops of special countries.

## Market gardens in different regions of Germany

**Background:** Delivery contracts for farms with a production area of 10 ha  
Quantities of vegetables to be delivered over the growing season

### Information about crops and their quantities (or area of cultivation)

Crops	Quantity Per date	Unit	No Of sets	Date of delivery
<b>Crops to plant</b>				
Lettuce	400	heads	13	Weekly from week 17/18 on
Batavia lettuce, red	500	heads	13	Weekly from week 17/18 on
Batavia lettuce, green	400	heads	13	Weekly from week 17/18 on
Red oak leaf lettuce	500	heads	13	Weekly from week 17/18 on
Green oak leaf lettuce	400	heads	13	Weekly from week 17/18 on
Iceberg lettuce	400	heads	13	Weekly from week 17/18 on
Romana lettuce	300	heads	13	Weekly from week 17/18 on
Chicory	200	heads	13	Weekly from week 17/18 on
Radicchio	400	heads	13	Weekly from week 17/18 on
Endive	400	heads	13	Weekly from week 17/18 on
Kohlrabi, red	300	heads	13	Weekly from week 17/18 on
Kohlrabi, white	600	heads	13	Weekly from week 17/18 on
Cauliflower	320	heads	6	Weekly
Broccoli	200	kg	5	Weekly
Chinese cabbage	600	heads	9	Weekly
Brussel sprouts	5000	m <sup>2</sup>	1	End of Nov till Jan
Red cabbage (spring, summer)	500	heads	4	4 times
White cabbage (spring, summer)	2000	heads	3	3 times
Red cabbage (to store)	2000	heads	1	*

**Table 2/2**

<b>White cabbage (to store)</b>	8000	heads	1	
<b>Savoy cabbage</b>	8000	heads	1	
<b>Fennel</b>	200	heads	8	weekly
<b>Celeriac</b>	10000	heads	1	
<b>Celery</b>	1000	heads	4	
<b>Leek (early)</b>	2500	m <sup>2</sup>	1	
<b>Leek (late)</b>	4000	m <sup>2</sup>	1	
<b>Onion (from onion set))</b>	2500	m <sup>2</sup>	1	
<b>Courgette</b>	200	kg	3	weekly
<b>Pumpkin</b>	5000	m <sup>2</sup>	1	

### Crops to sow

<b>Lamb's lettuce</b>	1000	m <sup>2</sup>	5	
<b>Carrot (fresh consumption)</b>	1000	m <sup>2</sup>	5	
<b>Pastinacs</b>	1000	m <sup>2</sup>	1	
<b>Parsley root</b>	1000	m <sup>2</sup>	1	
<b>Beetroot</b>	1000	m <sup>2</sup>	3	
<b>Garden radish</b>	1000	Bd/20 tubers	13	Weekly from week 17 on
<b>Winter radish</b>	1000	m <sup>2</sup>	1	
<b>Spinach (Fresh consumption)</b>	600	kg	6	6 times

\* If no date is mentioned plan for the potentially earliest date of delivery

# What do you know about botanical facts and essential (soil-born) diseases of vegetables?

Continue the listings ....

Pflanzkulturen:	Crops to plant	Botanical family		Diseases	<i>Lat Name</i>
Kopfsalat	Lettuce	AST	Asteraceae	White mold	<i>Sclerotinia sclerotiorum</i>
Blumenkohl	Cauliflower	BRA	Brassicaceae	Clubroot	<i>Plasmodiophora brassicae</i>

File: Vegetable Rotational planning.xlsx  
Register: **Botany**

# Which other rotation-related facts do you know about the vegetables listed?

Continue the listings ....

Crops to plant	should follow after ...	Should not follow after ...	Positive precrop for ...	Negative precrop for ....	Years to wait
Lettuce	Celeriac, cabbage				4
Cauliflower					4

File: Vegetable Rotational planning.xlsx  
Register: **Rotation**

# Which area is necessary according to density?

Crops as transplants	to deliver	Unit	Distance		Number $m^{-2}$	Netto $M^2$	Loss	Brutto $m^2$	Total $m^2$	No sets
			Distance In row	Distance Between row						
Lettuce	400	Piece	0.3	0.3	11.11	36	0.3	46.8	608.4	13
Broccoli	200	kg	0.5	0.5	4.00	200	0.2	240	1200	5
Brussels sprouts	5000	$m^2$	0.6	0.7		5000	0.2	6000	6000	1

File: Vegetable Rotational planning.xlsx  
 Register: **Growing area**

# Which quantity of nutrients are necessary for estimated yields? (1/2)

The German IGZ (Institute of Vegetable & Ornamental Crops) provides a very useful collection of relevant data for such calculations. The 'small' disadvantage of data for conventional production is compensated by reduced estimations for organic production. If complete data collections would exist for organic production the database could be replaced and calculations would follow the same scheme.

File: Vegetable Rotational planning.xlsx  
 Register: **Nutrient management**

Nutrient uptake

*Copy the programming of row 5 into those rows that correspond to selected vegetables  
 data from 'N\_Expert' are immediately transferred into this table. Similar numbers in column A are the reference.*

Yield [kg ha<sup>-1</sup>]

	Crops as transplants	t ha <sup>-1</sup>	N_t	N_h	N_r	P_t	P_h	P_r	K_t	K_h	K_r	t total
1	Lettuce	42	76	63	13		10.5			105		h harvest
2	Cauliflower	56	177	69	108		11			74		r residue

*Try to become familiar with the Excel command VLOOKUP().  
 This helps to accelerate the transfer of data from one sheet into another.*



# Which quantity of nutrients are necessary for estimated yields? (2/2)

File: Vegetable Rotational planning.xlsx  
 Register: **N\_Expert**

Nr	Kulturname	Total yield			Saleable yield						Residues			
		Organic (.7 of conv)		org	Organic		org	P	K	P	K	Organic		org
		t ha <sup>-1</sup>	N ppm	N kg ha <sup>-1</sup>	t ha <sup>-1</sup>	N ppm	N kg ha <sup>-1</sup>			P kg ha <sup>-1</sup>	K kg ha <sup>-1</sup>	t ha <sup>-1</sup>	N ppm	N kg ha <sup>-1</sup>
2	Blumenkohl Cauliflower	56	3160	177	24.5	2800	69	450	3000	11.0	73.5	31.5	3400	107
1	Kopfsalat Lettuce	42	1800	76	35	1800	63	300	3000	10.5	105.0	7	1800	13

*Essential numbers for the data-transfer from N\_Expert-sheet into Nutrient management-sheet*

## Example for calculation:

$$\text{Nutrient [kg ha}^{-1}\text{]} = \text{Yield [t ha}^{-1}\text{]} * \text{Nutrient content [ppm (= .001 g t}^{-1}\text{)]}$$

Cauliflower: saleable yield **24.5 t ha<sup>-1</sup>**, N **2800 ppm** (saleable yield) >> **69 kg N ha<sup>-1</sup>**

# What do you know about the climate of the selected site?

- Find relevant data for temperature and rainfall of the most recent year, in closest proximity to your site
- Build up a graph of rainfall sums per month (column, 1. y axis) and average of temperature per month (line, 2. y axis)
- The number of scales should be similar for both axis, not the absolute scales
- ***Additional data about soil type & altitude should also be collected for a more precise description of the selected site of production***

File: Vegetable Rotational planning.xlsx  
Register: ***Climate***



# Before presenting your results

The use of pivot tables in Excel is highly recommendable

- for the showing (table or graph) the shares of different botanical families
- for the documentation of nutrient flow per year  
(available nutrients for crops vs. exported nutrients)

*Note:*

*Tables and graphs should not be overloaded ('less is more'), appropriate letter sizes help your audience to follow your figures and understand your presentation and your interpretations*