Scoping mission
Impact Cluster onions Senegal

19-25 September 2022

Mission report

MEYS
EMERGING MARKETS RESEARCH

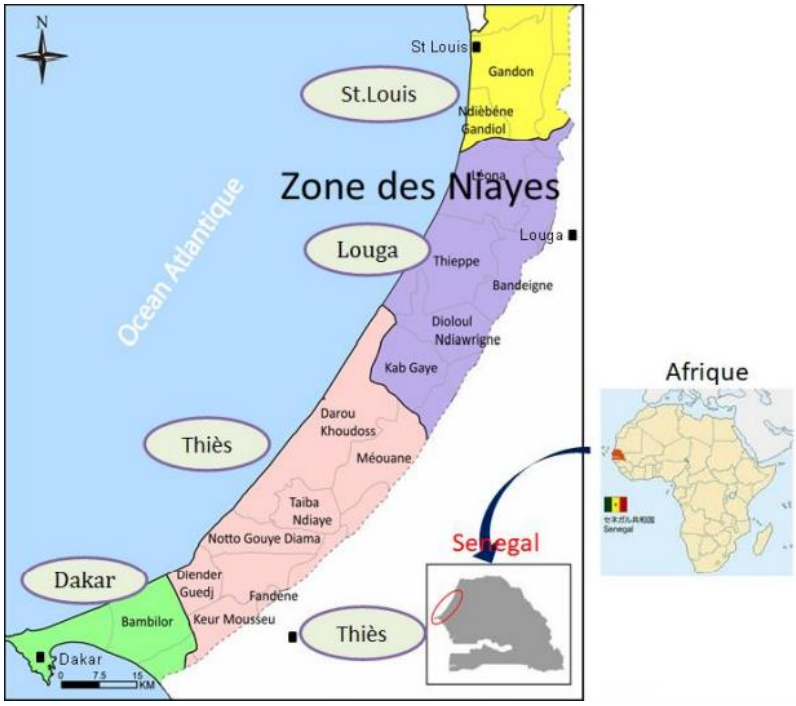
Delphy

The Salt Doctors

CONTENT

Introduction

During a scoping mission from 19 to 25 September Mink Vermeer of Delphy and Marco Rensma of MEYS Emerging Markets Research visited the Niayes in Senegal. The Niayes stretches from Dakar to Saint-Louis on a coastal strip 30 km wide and about 200 km long and is divided in 3 zones: the North consisting of the administrative regions of St. Louis and Louge; the Central consisting of the region Thiès; and the South covering the region of Dakar. Agriculture is the main economic activity with two seasons, planting during the rainy season that runs from June to September, and harvesting during the dry season from October to May.



The objective of this mission was to investigate the possibilities for setting up an Impact Cluster project (IC project) with local partners aimed at strengthening the local onion value chain. This scoping mission was co-funded by the Saline Water & Food System Partnership, which is convened by the Netherlands Food Partnership and the Netherlands Water Partnership.

In the following the results of the scoping mission is given with some relevant background information about the onion sector in Senegal and more specifically in the Niayes region.

Program scoping mission

Day 1: Monday, September 19

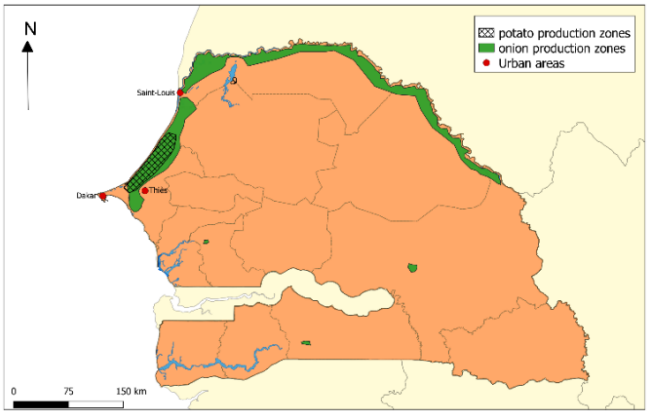
- Arrival Mink and Marco at Dakar Airport
- Pick-up by local driver from the airport and transfer to hotel Residences Bleu in Thiès

Day 2: Tuesday, September 20

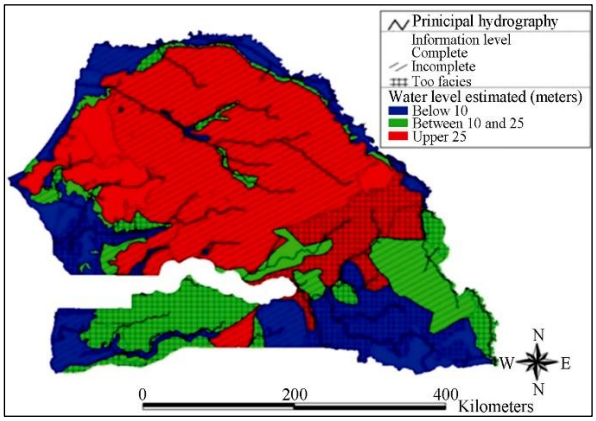
Visiting the *Association des Unions Maraîchères des Niayes* (AUMN) in Thiès, represented by the coordinators Mr. Mamadou Ndiaye and Mr. Yoro Saw. AUMN is the main farmers organization that brings together 22,000 producers (11.200 females, 10.800 males), 22 unions and 400 groups. Present in 4 regions (Dakar, Thiès, Louga and Saint-Louis). The average plot size of the member producers is 0,5 - 3,0 ha with a total area of 10 000 ha. About 20 large farmers with a maximum of 10,0 ha of land. They own their land.

Total onion production in Senegal is around 400 000 tons per agricultural campaign, making it the main vegetable crop of the country. This is followed by potato production with 140 000 -145 000 tons per agricultural campaign. The most important area for onion production is the Niayes. Approximately two-thirds of national onion production comes from farmers in the Niayes, followed by thirty percent in the Senegal River Valley and the remainder from other regions in the country. Within the Niayes onion production is primarily done in the Northern zone of St. Louis and Louga. In the Central and Southern zones of the Niayes potato cultivation is number one followed by onion.

Production zones for onion and potato



Water depths Senegal



The harvest season for onions in the Northern zone of the Niayes starts in February and last until August, while in the Central and Southern zones it is from March until July with a peak in May and June. The harvest season largely coincides with the rainy season in Senegal.

Figures members AUMN

Crop	Harvest period	Area in ha (2020)	Average yield MT/ha	Tonnage in MT
Onion	Feb - Aug	6.133	25	153.325
Potato	Jan - May	2.131	25	53.275
Carrot	Dec - July	184	27	4.968
Cabbage	Year round	1.483	23	34.109
others		69		

In the Niayes we distinguish 3 zones with different water layers. 1) water layer at 5-6m deep, 2) water layer at 6-15m deep, and 3) water layer at 20m and deeper. More water is used than the re-filling capacity.

According to AUMN in the last 10 years more land is abandoned due to high salinity (started in the north), late blight appeared, nematodes give a challenge, and weeds are an issue. Organic matter of the loamy sand is very low. pH = 5,0-7,0. The main crop exported is mango. Most produce is for the internal market (local or regional). Once AUMN had a deal for 30 containers of onions, but as they could only fill up 2 containers with the quality onions required, the deal was off.

Meeting with Mr. Mamadou Ndiaye (far left) and Mr. Yoro Saw (2nd from right) of AUMN - Thiès

The Senegalese market of seed suppliers is dominated by Tropicasem[1]. They have a national market share of 48%. Second is company Traoré et Fils[2] with a share of 29%, SPIA (16.1%), and Niayes Sarraut (16.1%). Dutch companies Bejo Zaden and East/West Seed have a market share of less than one percent.

Family farms in the Niayes faces certain constraints of a natural, technical, organizational and economic nature. These constraints were not only mentioned by AUMN, but also by other organisations and farmers contacted by Mink and Marco:

Degradation of natural resources

The degradation of natural resources observed is linked to deforestation, excessive use of chemical inputs, monoculture which have created an imbalance of ecosystems making them more vulnerable to the effects of climate change. Despite the advanced degradation of soil fertility, producers continue to increasingly resort to synthetic fertilizers. These products, in addition to being factors of degradation, cause serious economic damage to family farms insofar as their share in the operating expenses are quite high (between 14 and 20%). The excessive use of chemical fertilizers is linked to the difficulty of access to organic fertilizers, but also to the fact that many farmers do not measure the negative effects of this practice on the soil (salinization, acidification, soil texture degradation, leaching of nitrogen due to wrong timing). Especially salinization has become a real threat to food security in Senegal. According to the National Academy of Sciences and Techniques of Senegal (ANSTS) 6% of the country's total land area – or 1.3 million ha., is affected by salinization contributing to the increase in rural-urban migration. More specifically the regions of Sine Saloum, Kaolack, Fatick, Ziguinchor and the Senegal River Valley are the most affected by salinization. According to ANSTS the salinity is estimated at 9% in the Niayes and at 20% in the groundnut basin (Kaolack, Fatick). On the other hand, it is between 26 and 37% in eastern Senegal and between 36 and 53% in Casamance to reach a maximum of 66% in the River Valley region.

Beyond the erosion and degradation of land quality, the increasing urbanization coupled with major state projects and the overexploitation of groundwater by large companies currently constitute serious threats to the horticultural future of the Niayes area.

[1] Tropicasem is the local distributor of the French group Novalliance. Tropicasem sell the brands Technisem, Tropica, Jardinova, and Jarditropic in Senegal.

[2] Traoré et Fils is a company based in Dakar and already active for more than 40 years. They are also selling in other countries in West and North Africa.

Difficulties in accessing water and equipment

Access to water remains the major problem for family farms throughout Niayes. Some of them by lack of means and / or alternatives depending solely on rainfall. However, in recent years low amounts of rain that are poorly distributed throughout the agricultural season contributing to the drop in yields and, more often, the agricultural income of producers. In areas where irrigated agriculture is developed, the problem of water control is often posed. The investment costs (digging of wells, development of water channels, building of pumping stations, etc.) are generally not within the reach of family farms.

In addition to the issue of water, there is also that of agricultural equipment, especially for rain fed agriculture. Most family farms practicing this type of culture are equipped with rudimentary and often dilapidated equipment consisting of an artisanal hoe and a manual seeder. There is often a deficit in public (financial) support for the renewal of the farm equipment acquired. The little subsidized equipment benefits a minority often close to the public authorities or large producers to the detriment of the most deprived family farms. The other difficulty often cited is that subsidized agricultural equipment is not always adapted to the soil characteristics of the Niayes or which does not have spare parts (eg. tractors).

The lack of post-harvest infrastructure (packaging, processing and storage units) for certain crops such as rice, onions, tomatoes and potatoes is also a major issue for farmers in the Niayes. As an example, the case of the onion sector, which lacks storage warehouses to allow quality in production to be maintained throughout the year. Besides a doubling in national production since 2012, it is insufficient to meet domestic demand due to high post-harvest losses estimated at 30% (8 months coverage of national needs). As the local marketing campaign of onions lasts only six months, the level of imports to fill this gap is still important with an average between 120 000 – 180 000 tons per campaign[3] during the last eight years. Imported onions having a higher quality are put on the Senegalese market at the same time when local farmers are harvesting, leading to an oversupply with falling market prices. As a result lower incomes for family farms making it for them difficult to invest in better storage facilities for next year campaign.

Difficulties in accessing credit and marketing

The problem of access to credit also arises above all for family farms, when it comes to financing investments. Indeed, the current approach of the public authorities in supporting family farms is mainly limited to the provision of guarantees from banks for lines of credit. Generally, family farms are faced with the difficulties of access to credit because of the interest rates charged, the duration often reduced to the length of an agricultural campaign and sometimes to the obligation to provide guarantees of repayments. The credit system in place favours holders of capital (especially land) and bank guarantees more than family farms. This is what pushes more than 2/3 of family farms to turn away from formal institutions of financing to short term contract credits from other actors (traders, relatives, etc.). The credits granted by traders are generally granted in the form of inputs (seeds, fertilizer) with contracts for the purchase at farm gate production prices. While this method eliminates the need for expensive bank credits, it also limits producers' room for manoeuvre in marketing their production.

The marketing of the production of family farms is often considered as the weak link in the agricultural value chain. Indeed, the difficulties in accessing the national market constitute a handicap in the search for added value. If it is not the lack of transporting the crops to the market centers, it is the presence of intermediaries at all levels that reduces the possible margins for producers (family farms).

The lack of organization among local farmers is also observed with market regulation, in order to face the dominance of the local trader or "bana bana" on the fixing of the price and the difficulty of receiving credits from them. Farmers are often in situations that push them to accept credit terms against them. Therefore, there is a need to support farmers and their organizations, to better negotiate the sale prices of their crops.

[3] In 2021 around 177,000 tons of onions was imported by Senegal, of which 144,000 tons from the Netherlands alone. Over the last couple of years the share of Dutch onions in Senegal's total onion imports is between 80-85% (source: ITC).

Mr. Ndiaye of AUMN informed us to contact *Association Producteurs Marachaires Kayar* (APMK) for a visit and meeting in the small city of Kayar, located 25 km from Thiès, and to check the surrounding land area. In the Kayar area farmers abandoned their land due to salinity problems.

Day 3: Wednesday, September 21

In the morning driving from Thiès to Dakar where there was a meeting with representatives of International Fertilizer Development Center (IFDC) at their office in Dakar. Present during this meeting were Dr Mbène Dièye FAYE, agronome Sansan YOUL, and Dr Bocar N. DIAGANA. IFDC is located for two years now in the former office of Senegal's agricultural research center ISRA (*Institut Sénégalais de Recherches Agricoles*). The HQ of IFDC is in Alabama, USA. IFDC has 9 offices in Africa and Asia. Dr Bocar is the vice director for the African region. IFDC's mission is to 'bring together innovative research, market expertise, and strategic public and private sector partners to identify and scale sustainable solutions for soil and plant nutrition that benefit farmers, entrepreneurs, and the environment.' They have a fertilizer project with micro dosing in Senegal. Technical package with improved seed and GAP, but rotation of onion is not applied. Reinforcement of private sector, intervention with credit, developing platform with technical data sheet and cartography.

IFDC runs a 4-year (Oct 2019 – Sept 2022) 8 million US$ subsidy program for onions and potatoes financed by USAID called 'Dundël Suuf' ('nourishing the soil' in Wolof). They work on demonstration fields of 50ha and 100ha.

Visiting IFDC in Dakar

In the afternoon Mink and Marco had a meeting with local CORDAID coordinator Mr. Idrissa BA. He works already for five years in the agricultural sector in the Niayes region and in the North. He coordinated among others an ICCO (now CORDAID) project, funded by the Mastercard Foundation, aimed at supporting smallholder farmers to overcome the problems of Covid-19. He stressed that one of the main problems for small farmers is the availability of good and affordable (cold) storage facilities. He has experiences with simple local storage of onions and potatoes. Mr. Ba also mentioned the project of Dutch company Agro Expedition. They have invested in a cold storage facility of 1 500 ton capacity near Thiès. This facility was initially aimed at potato storage, but now also offers the storage of onions. Recently Agro Expedition expanded their potato storage capacity. The first storage room and also the expansion is built by Dutch company Hanse Staalbouw. Other Dutch companies active in the Senegalese onion value chain are Bejo Zaden, Enza Zaden and East/West Seed. Dutch company Primeale United (previous Van Oers United)[4] is also active in Senegal with the production of haricot verts.

In Senegal the annual per capita consumption of onions is on average 32.8 kg, resulting in a total consumption demand of approximately 580 000 tons of onions per year. Annual local production is on average 400 000 tons, but 30% of this production is lost due to post-harvest losses. Especially the lack of cold storage facilities is an important factor for the relatively high losses in Senegal. That means that each year around 175 000 tons of onions must be imported to fulfill national consumption needs. This is

[4] In 2015 Van Oers United became a wholly subsidiary of French multi-national Agrial. Since June 20, 2022 the label Van Oers United changed into Primeale United.

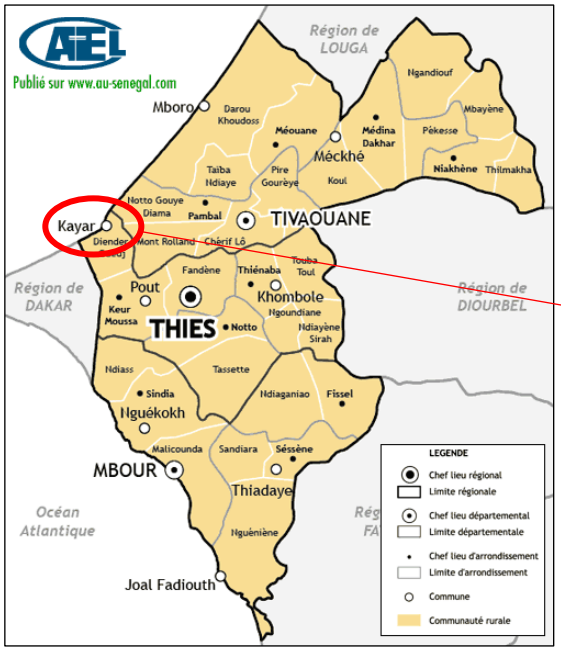
primarily done by importing from the Netherlands. Besides using better seeds that can stand high salinity and improving cultivation techniques (e.g. crop rotation), knowledge about how to store onions (drying with forced air system) and more (cold) storage facilities can decrease post-harvest losses substantially, making Senegal less dependent on onion imports[5].

Main financial institutions for providing credits and loans to the agricultural sector in Senegal are COFINA (*Compagnie Financière Africaine*), CAURIE-MF (*Coopérative Autonome pour le Renforcement des Initiatives Economique par la MicroFinance*), UM Pamecas (*Union des Mutuelles du Partenariat pour la Mobilisation de l'Epargne et le Crédit*) and CNCAS Banque Agricole.

Mr. Ba of CORDAID informed Mink and Marco that CORDAID is ready to cooperate in any phase of the IC-project.

Day 4: Thursday, September 22

To investigate the problem of salinity with local farmers, Mink and Marco left with the local driver Thiès in the morning for the small town of Kayar (23 000 inhabitants). This city lies 25 km from Thiès, located along the Atlantic coast. The team met with Mr. Mouhamed Bachie NIANG (treasurer) and Mr. Mbaye NDOYE secretary general of the *Association Producteurs Marachaires Kayar* (APMK). This farmers organization has 800 members (25% female, 50% young, 25% adults) and 1 000 ha. of crop land. The main crop cultivated is potato, followed by onion, carrot, cabbage, turnip, eggplant, okra and tomato. They also have some hectares of fruit trees. An increasing number of plots have been abandoned due to the growing problem of salinity. Especially plots were onions have grown.



Taking soil and water samples during a field visit near the small city of Kayar

Soil and water samples 1K, 2K (see Appendix) were taken from plots of APMK members just outside the centre of Kayar, approximately 1 km from the Atlantic coastline.

In the afternoon Mink and Marco went with the local driver to the small city of Notto Gouye Diama (40 000 inhabitants), located near Thiés, and met with Mr. Yankhoba NDIAYE chairperson of *Union des Groupements et Associations Paysannes des Niayes Sud* (UGAPNS Notto). The association has 400 members (25% female). They grow mainly potato on 150 ha. out of a total of 2 000 ha. They cultivate potato from

[5] The annual costs for Senegal of importing onions is between 30-35 million euros (source: ITC)

November to March, from March to July cabbages, onions, capsicum, carrots, and then again potatoes. They have no storage facilities and leave the potatoes in the field. Post-harvest losses are up to 30% caused by low prices - therefore not bringing to the market - or rotten potatoes. Suppliers of plant materials are Germicopa (FR) and HZPC (NL). Varieties used are Spunta, Dafila, Naïma, Sahel, Alberda. Late blight appears in February.

After the visit in Notto Mink and Marco went back to the hotel in Thiès and met early in the evening with Mr. Moctar FALL, director-owner of Agroseed which is the local representative of Dutch company RijkZwaan in Senegal, and his business partner Mr. Christophe GUIET (representing DROM: Martinique, Guadaloupe, Guyane, Mayotte, La Réunion). Mr. Fall gave us a brief overview of the onion market in Senegal (which is already mentioned in the previous pages of this report) and talked about his efforts to set up, together with GreenTech Holland, Koppert, RijkZwaan, an Impact Cluster project in Kirène.

Day 5 : Friday, September 23

Together with the local driver Mink and Marco went in the morning to the site of Dutch farmer Hans Ham, about 30min. driving from Thiès, close to Dakar airport. Hans Ham worked for many years in the maritime sector before he went working for Dutch company J.P. Beemsterboer. J.P. Beemsterboer started in June 2017 with a plot of 100 ha. for growing onions. The aim of this project is to fill the gap when there is a freeze on imported (Dutch) onions during the period from February until September[6] to protect the local growing season in Senegal. From the start of the project Bejo Zaden delivers the onion seeds (variety Orient F1). Beemsterboer invested much in the infrastructure around the village were the plot is located, which had a major impact on the local population. They built a road, invested in a health post with first aid, a nursery and a training center for local (would be) farmers. Recently Hans took over the project from Beemsterboer. He know produces on average 40 000 tons per year, not only at the location visited but also at 4 other locations in Senegal. During planting and harvesting he works with 200 – 300 people from the surrounding villages. Together with RESOPP (*Réseau des Organisations Paysannes et Pastorales du Sénégal*)[7] Hans started a small experiment with 30 farmers (2 females, 28 male) from various regions on how to grow (better) onions. The participants receive one week training with 5 modules. After the training they will grow onions in their own fields, with support from Bejo Zaden (André Dekker). One of the issues Hans mentioned in regards to training local farmers is that they (farmers) hardly speak French (only 1 of the other 5 main languages spoken in Senegal) and having trouble with writing and reading. In addition to the language barrier is the lack of money to invest in better seeds, farm equipment, fertilizers, storage rooms, etc. to improve quality of production and reduce post-harvest losses.

Onion field of Hans Ham

[6] Besides a closing of the border for imported onions, there is also a quota for imported onions during the period thereafter. These volumes are controlled by the Market Regulation Agency (*Agence de Régulation des Marches* - ARM), who issues import permits.
[7] RESOPP is a union of rural cooperatives created in 2002 and approved in 2007 by the Ministry of Agriculture. Its headquarters and training center is located in Thiès. RESOPP composes of 37 cooperatives and a Savings and Credit Bank (COOPEC-RESOPP) spread over 8 regions and 11 departments. The main objective of RESOPP is to improve the livelihood of farmers from the member cooperatives.

At the end of the meeting Hans mentioned that he is willing to invest in the IC-project in regards to the (cold) storage of onions if we could improve the quality of the onions to be stored. That means training the farmers involved in the IC-project and providing them with better seeds and farm equipment.

After the visit with Hans Ham Mink and Marco went back to Thiès for a meeting with the director of ENSA (*Ecole Nationale Supérieure d´agriculture de Thiés*) Mr. Ibrahima DIEDHIOU. ENSA is since 2006 part of the University of Thiés and focus on the training of agricultural engineers and specialists. ENSA also develops activities of technology transfer, promotion of knowledge resulting from agricultural research, support for innovation and business creation, dissemination of scientific and technical culture. They work closely together with many different agricultural research organizations in Senegal including ISRA, ANCAR and SAED. When talking with Mr. Diedhiou about the IC-project he informed that ENSA could train the farmers involved in the project after ENSA trainers (teachers, researchers, master students) were trained by the IC team (train-the-trainer concept). ENSA has exchanges with 2 universities in Belgium, many universities in France, and in the USA (Michigan, Virginia, Ohio). ENSA would like to work with WUR as well.

In the evening Marco flies back.
Saturday, September 24; Mink packs soil samples according EU rules.
Sunday, September 25: Mink flies back

Conclusions

Strengthening the local onion value chain in the Niayes through an Impact Cluster project will have an enormous impact on the rural households involved. Problems of salinity, lack of knowledge on rotational cultivation, poor farm equipment and inadequate post-harvest infrastructure (including cold storage facilities) are all undermining a healthy local onion sector. A sector that could compete with imported onions from Europe on quality and price.

During the scoping mission it was noticed that there is great willingness among the local organizations visited to cooperate with the Dutch companies who take part in the IC -project. What became clear from the mission was that the way an IC project is organized with co-funding from local partners is not always understood well by the local interlocutors. Most of the international projects initiated in Senegal work in a more 'traditional' way of funding, either through subsidies or cheap loans for individual farmers and associations for buying farm inputs (seeds, fertilizers) and equipment. The latter often supplied by companies from the funding countries.

As the vast majority of farmers are subsistence farmers cultivating a single crop on plots of less than 5 ha., local partners for the IC project cannot be these small individual farmers. A local partner must therefore be a farmers' association with a substantial amount of members and cultivable land to make an impact. The farmers' association in Kayar APMK can be such a partner. With 800 members and 1,000 ha. of cropland they fulfill an important social and economic role in the Kayar region. Supporting APMK through an IC project means supporting not only the 1,000 individual farmers but also the hundreds of households of these farmers who depend on their food intake and income on what is produced and sold from these small plots.

During the discussions and field visit in Kayar it became clear that the farmers there have a problem with salinity, resulting in abandoning their farm plots all together. Furthermore, there is no storage infrastructure and farm equipment is limited let alone mechanized farm equipment. APMK has a building from where they operate, including a class room, PC and printer. The city of Kayar is easily accessible by car from Thiès. APMK seems open to cooperation, although during the visit there were no in-depth discussions about their possible role/position and co-funding in the IC-project. APMK already has a Dutch connection, namely they buy seeds from Bejo.

Regarding the training of local farmers as part of the IC-project, ENSA could play this role as they have the facilities to do so. Training directly by the IC-members is not doable, due to language barriers (most of the farmers don't speak French, only Wolof or other dialect). Therefore, IC-members should train ENSA staff who will then train local farmers from Kayar in their own language. But the local farmers don't have the budget to come to Thiès by taxi or bus, so it is better to do training at the building of APMK. That means that ENSA trainers must travel to Kayar to do the training on the spot.

Besides improving cultivation techniques, production and quality of onions, diminishing post-harvest losses by constructing storage facilities is key in this IC-project. Dutch onion grower Hans Ham has much experiences in setting up such facilities. He offered his assistance to this part of the IC-project, although more specificities about this contribution (in-kind, subsidy, loan, etc.) were during the scoping mission not further discussed.

Based on the visit and discussions with IFDC the conclusion can be drawn that this organization will and cannot be the financial partner of the IC-project. Other local financial institutions like PAMECA, COFINA, CAURIE-MF and Banque Agricole are set up for the purpose to fund the agricultural sector in Senegal, and are therefore more suitable candidates as a financial partner for the IC-project. Due to limited time and the

fact that it was recommended to contact these organizations through the Dutch embassy – which was not done at beforehand – it is unclear at the moment if one or more of these financial institutions are prepared to cooperate in the IC-project. Also, it is therefore unknown against which conditions they would cooperate.

Recommendations

Based on the experiences from the scoping mission the following recommendations can be made to develop an IC-project in strengthening the local onion value chain in the Niayes in Senegal:

- Focus on the Kayar area and set up a cooperation with farmers' association APMK
- Core team for the IC-project consists of the three companies Delphy, MEYS and The Salt Doctors
- Besides the core team, other Dutch and Senegalese organizations can be involved in parts of the project
- Set up a cooperation with ENSA for train-the-trainer approach
- Co-funding from APMK cannot be in cash, but should be in putting in the land of the farmers involved with the IC-project and free of charge in the usage of their building
- Co-funding from ENSA cannot be in cash, but should be in-kind like the hours of the staff and free of charge of a class room at the university for the train-the-trainer program
- Financial partner should be one of the leading lending institutions for farmers in Senegal, namely PAMECA, CAURIE-MF or COFINA
- Local project partner is necessary to make a success of the IC-project in Senegal. Start talks with Mr. Idrissa BA, local project coordinator of ICCO/CORDAID, for filling in this role
- Further discussions with Hans Ham about his involvement in the IC-project in regards to storage facilities

APPENDIX 1. Soil sample analysis

1K:

• Sandbox, with normal to high pH for sand

• Lots of phosphate in the soil, heavily fertilized with fertilizer?

• Potassium very low, both available as soil stock

• Calcium low, no Calcium carbonate present. But this is not strange for sandy soil. But also available/absorbable Calcium low, which does require attention in fertilization.

• Magnesium reasonable, but necessary to fertilize

• Hardly any organic matter, so sensitive to drought/irrigation. Water storage capacity is low, so leaching is fast. nitrogen supply from the soil virtually zero.

• Very low CEC, little capacity to retain minerals due to low organic matter content and large sand fraction.

• Little fertile soil, more substrate than agricultural land

• Supply of organic material very useful!

2K:

• sandbox with very little organic matter. Probably quite drought-prone/irrigation-requiring. Water storage capacity is low, so leaching is fast.

• Given a lot of phosphate (?) / very high phosphate status.

• Potassium, Calcium, Magnesium reasonably OK

• High pH, with a low percentage of Calcium carbonate. Much limed in recent years? Also because readily available Calcium is relatively high

• Low CEC, so little capacity to retain minerals. Caused by low organic matter and high sand fraction. So also not very fertile, more substrate than agricultural land.

• Supply of organic material very useful.

Poor sandy soil, very low in organic matter (semi-desert?)

2K: high in nitrogen and phosphate

Low in trace elements, so be aware of deficiency diseases.

High pH! This increases the risk of Manganese deficiency!

1K is low in nitrogen, other elements are also less available.

APPENDIX 2. Water sample analysis

1K water is not suitable for irrigation. Salt content is much too high and there is way to much Boron (B) present.

2K water is much better, but still not suitable for irrigation. Salt content is too high (Na, Ca, Cl)

FertilizationManager

1K

Your client number is: 8240159

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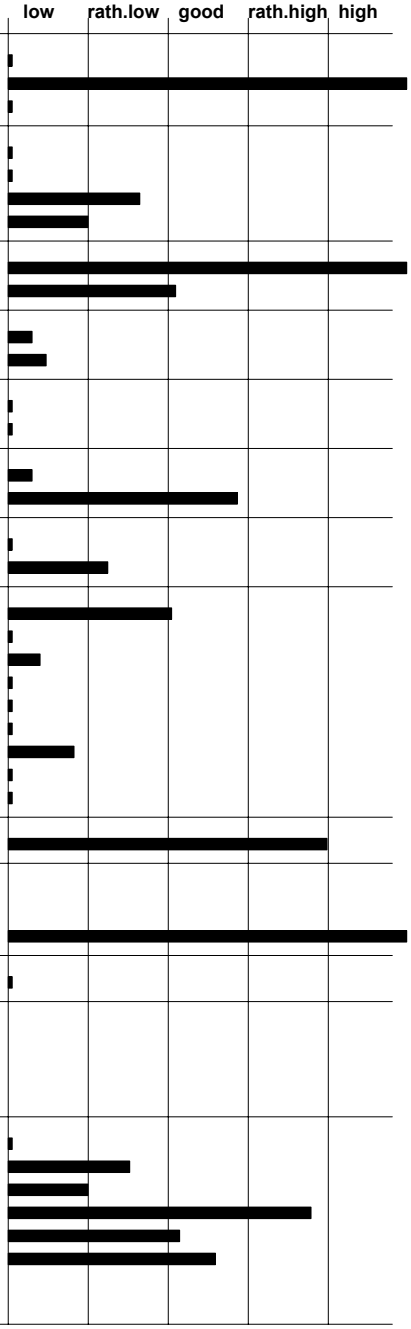
Analysis | Investigation/ordernr: 801750/005854579 | Date sampling: 27-09-2022 | Date report: 19-10-2022

Results		Unit	Result	Target value
Chemical	Total N stock	kg N/ha	< 700	780 - 1170
	C/N ratio		31	13 - 17
	N-supplying capacity	kg N/ha	0	95 - 145
	S-plant available	kg S/ha	< 4	20 - 30
	Total S stock	kg S/ha	< 520	170 - 315
	C/S ratio		41	50 - 75
	S-supplying capacity	kg S/ha	10	20 - 30
	P-plant available	kg P/ha	25,0	6,3 - 10,4
	P-soil stock	kg P/ha	545	530 - 685
	K-plant available	kg K/ha	50	245 - 385
	K-soil stock	kg K/ha	95	245 - 380
	Ca-plant available	kg Ca/ha	30	250 - 585
	Ca-soil stock	kg Ca/ha	1465	2745 - 3490
	Mg-plant available	kg Mg/ha	65	245 - 385
	Mg-soil stock	kg Mg/ha	180	125 - 190
	Na-plant available	kg Na/ha	< 21	52 - 104
	Na-soil stock	kg Na/ha	32	56 - 104
	Si-plant available	g Si/ha	24620	20870 - 90420
	Fe-plant available	g Fe/ha	< 6990	8690 - 15650
	Zn-plant available	g Zn/ha	350	1740 - 2610
	Mn-plant available	g Mn/ha	< 870	11130 - 17390
	Cu-plant available	g Cu/ha	< 75	140 - 225
	Co-plant available	g Co/ha	< 10	15 - 30
	B-plant available	g B/ha	305	555 - 765
	Mo-plant available	g Mo/ha	< 10	350 - 17390
	Se-plant available	g Se/ha	< 7,4	12 - 16
Physical	Acidity (pH)		5,9	4,9 - 5,5
	C-organic	%	0,6	
	Organic matter	%	0,7	
	SOC/SOM ratio		0,86	0,45 - 0,55
	Carbonate lime	%	< 0,3	2,0 - 3,0
	Clay (<2 µm)	%	3	
	Silt (2-50 µm)	%	8	
	Sand (>50 µm)	%	88	
	<16 µm	%	5	
	Clay-humus (CEC)	mmol+/kg	30	> 44
	CEC-saturation	%	88	> 95
	Ca-saturation	%	70	80 - 90
	Mg-saturation	%	14	6,0 - 10
	K-saturation	%	2,3	2,0 - 4,0
	Na-saturation	%	1,3	1,0 - 1,5
	H-saturation	%	< 0,1	< 1,0
	Al-saturation	%	< 0,1	< 1,0



TESTEN RvA L 122

Results

	Unit	Result	Target value	low	rath.low	good	rath.high	high
Electric Conductivity	mS/cm 25°C	0,29	0,60 - 1,2					

	Unit	Result	Target value	low	rath.low	good	very good
Soil crumbling	score	10,0	6,0 - 8,0				
Soil slaking	score	7,1	6,0 - 8,0				
Risk on wind erosion	score	5,1	6,0 - 8,0				

Biological

	Unit	Result	Target value	low	rath.low	good	rath.high	high
Moisture retention cap.	mm	38						
Microbial biomass	mg C/kg	15	35 - 105					
Microbial activity	mg N/kg	20						
Fungal/bacterial ratio		0	0,6 - 0,9					

Fertilisation recommendations
The result is compared with an agricultural target value and is categorized as low, rather low, good, rather high high. This is not an appreciation as meant in ISO 17025 (par. 7.8.6).
Legislation
The fertilisation recommendations aim to achieve an agronomical optimum yield and crop quality. The recommendations do not take any legal restrictions into consideration.

Recommend.

	Recommendation	Unit
Soil based recommendation		
Phosphate (P_2O_5)	0	kg/ha
Potassium (K_2O)	25	kg/ha
Calcium (CaO)	440	kg/ha
Magnesium (MgO)	0	kg/ha
Lime (nw)	0	kg/ha
Effective OM	0	kg/ha

When recommendations are high, it is adviced to split the amount during the 4 years, for instance supply half the amount biannially. The soil based recommendation is meant to level the soil stocks of phosphorus, potassium, calcium and magnesium to the required amounts.

The lime gift is based on an optimal pH of 5,2
For every tenth increase in pH a lime gift is required of 25 kg/ha.
The amount of effective organic matter needed is calcutated for a 4 year period. At the organic matter balance the yearly application of organic matter is calculated.

Recommend.		Crop	Culture	Recommendation
	Crop based recommendation (annual)			
in kg/ha	Nitrogen (N)	Ware potatoes		244
		Spring-sown onions		96
		Cabbage		176
		Onion sets	First year	80
		Summer carrots		80
	Sulphate (SO_3)	Ware potatoes		25
		Spring-sown onions		28
		Cabbage		115
		Onion sets	First year	0
		Summer carrots		153
	Phosphate (P_2O_5)	Ware potatoes		0
		Spring-sown onions		0
		Cabbage		0
		Onion sets	First year	0
		Summer carrots		0
	Potassium (K_2O)	Ware potatoes		355
		Spring-sown onions		125
		Cabbage		70
		Onion sets	First year	70
		Summer carrots		70
	Calcium (CaO)	Ware potatoes		105
		Spring-sown onions		150
		Cabbage		180
		Onion sets	First year	100
		Summer carrots		90
	Magnesium (MgO)	Ware potatoes		35
		Spring-sown onions		5
		Cabbage		5
		Onion sets	First year	0
		Summer carrots		15
	Sodium (Na_2O)	Ware potatoes		
		Spring-sown onions		
		Cabbage		
		Onion sets	First year	
		Summer carrots		
	Zinc (Zn)	Ware potatoes		0,5
		Spring-sown onions		1,0
		Cabbage		0,5
		Onion sets	First year	0,5
		Summer carrots		0,5
	Manganese (Mn)	-		See the explanation.
	Copper (Cu)	Ware potatoes		0,25
		Spring-sown onions		0,25
		Cabbage		0,25
		Onion sets	First year	0,25
		Summer carrots		0,25
	Boron (B)	Ware potatoes		0,5
		Spring-sown onions		0,5
		Cabbage		0,5
		Onion sets	First year	0,5
		Summer carrots		1,5

Crop based recommendation
The crop based recommendation is based upon the crop needs, average yields and climatic conditions and is corrected for soil nutrient stocks and the soil supplying capacity. If possible you can split the recommencation in several doses during the culture. During the growing season the SoilCropMonitor can be used for fertilization adjustments.

Explanation

The results and/or the recommendations of this analysis are valid until 2026
For more information please use the following link:
https://www.eurofins-agro.com/en/soil-analysis-explanation

The soil based recommendation aims to maintain the soil nutrient stocks. The K, Ca and Mg recommendation will optimize the balance at the cation-exchange-capacity (CEC). It is adviced to spread the soil based recommendation for nutrients and lime application across a 4 year period. When you have applied the soil based recommendation a new soil based analysis can be used to update the concentration of the nutrient stocks.

The crop based fertilization will feed the crop and improve its quality. Due to higher/lower yields and possible losses (e.g leaching) the amount of plant available nutrients can fluctuate. Therefore, we advise you to carry out a crop based analyis (Culture analysis) to determine the actual amount of available nutrients and to update the fertilization recommendations.

Look carefully at the appreciation of the nutrients on page 1. If the target values indicate that one or more nutrient quantities are very low, consult your advisor to level these quantities.

We have assumed the following yields, when calculating the crop based recommendations:

Ware potatoes	47,0
Spring-sown onions	49,0
Cabbage	40,0
Onion sets	25,0
Summer carrots	-

When your yield differentiates from the above, it is recommended to adjust your fertilization accordingly

Nitrogen:
The N recommendation relates to an annual dose. If possible, we recommend splitting this N dose into several applications. You can use our SoilCheck soil test in season to determine whether subsequent applications are necessary. This test measures the plant-available N (mineral N) in the soil among other things.

Sulphur:
Sulphur (S) is released by the degradation (mineralisation) of organic matter or manure. This mineralisation is performed by soil organisms. Soil organisms are not very active under colder conditions, which means not much S is released from the soil early in the spring. Therefore, it is sensible to fertilise with S for many early crops, even if the soil content is good or high.

Phosphate:
P-supplying capacity is 5 . The target range is 17 - 27
The P-buffering capacity indicates whether the P-soil stock is high enough to maintain the level of plant available P. When the buffering capacity (buffering power) is low, the plant available P will not remain on level during the growing season: it will decrease.

Potassium:

Calcium:
Fertilization with calcium may benefit the soil structure.

Manganese:
Manganese deficiency is to be expected.
During periods of rapid growth, please apply foliar fertilizers containing Manganese.

Clay-humus (CEC):
You can increase the CEC by applying organic matter and/or increase the pH of your soil.

Soil life:
The biological soil fertility is measured by 3 characteristics, the microbial biomass, the microbial activity, and the fungal/bacterial ratio.
The acknowledgement of the measured results is based upon the amount of organic matter. There is not a recommendation given for the measured characteristics. On the basis of research projects there will be more information available.

Organic matter

Figure: Organic matter balance

Yearly breakdown rate (percentage) of the total organic matter content (%): 2,1

Crop (residue)	Culture:	Input of effective organic matter
Ware potatoes		875
Spring-sown onions		300
Cabbage		1150
Onion sets	First year	300
Summer carrots		700

Average input/year		665

For increasing the soil organic matter content by 0.1%: 3480 kg effective organic matter per hectare is needed.

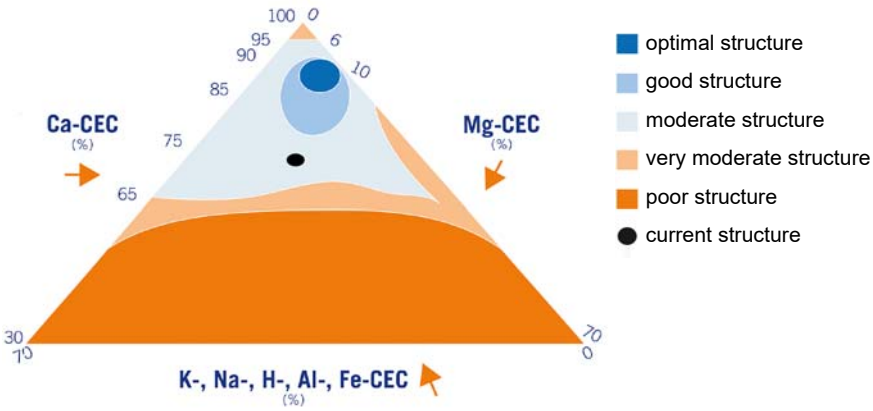
Figure: Quality of the organic matter

Organic matter consists primarily of C, N, P, S. If the organic matter contains relatively high amounts of N and/or S, this makes it attractive to soil organisms. Soil organisms happily eat this organic matter. N and S are released in the process and the amount of organic matter decreases slightly (dynamic organic matter). Organic matter can also contain a lot of C. This is generally less attractive to soil organisms (bacteria). As a result, the organic matter is not consumed as quickly by the soil organisms; making the organic matter more stable. Stable organic matter contributes - among other factors - to the workability of the soil and the looseness. Dynamic organic matter contributes primarily to the release of N and S and is therefore a source of these nutrients for the crop. The quality of the organic matter can be changed (gradually) by paying attention to the properties of soil improvers such as animal manure, compost and crop residues.

Physical

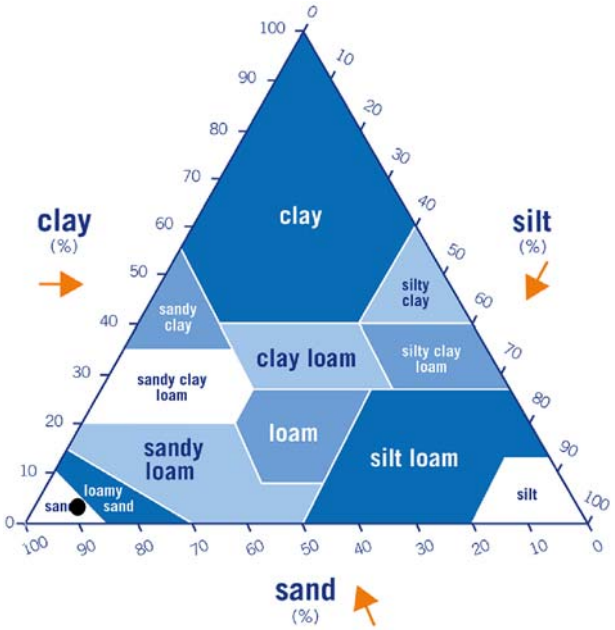
The assessment of soil structure is based on the Ca-CEC, K-CEC, and Mg-CEC ratio. Actual soil structure is - of course - not merely depending on ratio, but also on weather conditions, moisture condition of the soil, and the weight of the machinery.

Figure: Structure triangle



Physical

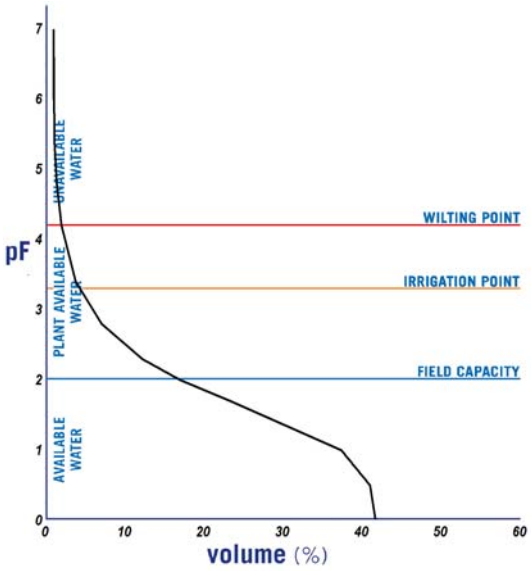
Figure: Texture triangle



Besides clay, the silt and sand fractions are presented as well. Clay is smaller than 2 micrometer (µm), silt particles are 2-50 µm and sand particles are larger than 50 µm. The relative distribution of soil particles is used to estimate the risk of slaking. Slaking causes the soil pores to be clogged with smaller particles and degrades soil structure. The risk of slaking is greatest at 10-20% clay.

Soil crumbling score is: good, however the evaluation of soil crumbling status is also depending on crop type.
Considering the results, the chance of soil slaking is small.

Figure: Water retention curve



The amount of plant available water in the sampled layer is 38 mm. This is the maximum amount you should irrigate. All excess irrigation will drain off the parcel or will sink to deeper layers.

Field capacity (pF 2,0):	17,1	% moisture
Irrigation point (pF 3,3):	4,3	% moistur e
Wilting point (pF 4,2):	2,1	% moistur e

Crops have difficulties to obtain water when the actual moisture level is below pF 3,3. When you are able to measure the moisture level, start with irrigation if the moisture content of the parcel is at 4,3 % and irrigate 32 mm.

The actual moisture level can be measured by using a soil moisture sensor, or collect soil from ten spots in the parcel. Measure the weight of the moist soil and the weight after 24 h drying. The difference between moist and dry soil is an indication of the moisture level of the parcel.

Contact & info

Soil layer:	0 - 25 cm
Sample was taken by:	Third party
Contact sample taking:	Alie Hissink: 0652561834

If the following information is shown in the reports, this information may have been provided by the client and may affect the valuation, advice and/or analysis result:
sampling depth, crop, culture.

1K

Method		Result	Unit	Method	RvA
Results analyses	Total nitrogen stock	< 200	mg N/kg	Em: NIRS	Q
	S-plant available	< 1,1	mg S/kg	Em: CCL3 (Gw NEN 17294-2)	
	Total sulphur stock	< 150	mg S/kg	Em: NIRS	Q
	P-plant available	7,2	mg P/kg	Em: CCL3 (Gw NEN 15923-1)	Q
	P-soil stock	36	mg P_2O_5/100 g	PAL1: Gw NEN 5793	Q
	P-soil stock	16	mg P/100 g	PAL1: Gw NEN 5793	Q
	K-plant available	14	mg K/kg	Em: CCL3 (Gw NEN 17294-2)	
	K-soil stock	0,7	mmol+/kg	Em: NIRS	
	Ca-plant available	0,1	mmol Ca/l	Em: NIRS	
	Ca-soil stock	21	mmol+/kg	Em: NIRS	
	Mg-plant available	19	mg Mg/kg	Em: CCL3 (Gw NEN 17294-2)	
	Mg-soil stock	4,3	mmol+/kg	Em: NIRS	
	Na-plant available	< 6	mg Na/kg	Em: CCL3 (Gw NEN 17294-2)	
	Na-soil stock	0,4	mmol+/kg	Em: NIRS	
	Si-plant available	7080	µg Si/kg	Em: CCL3 (Gw NEN 17294-2)	
	Fe-plant available	< 2010	µg Fe/kg	Em: CCL3 (Gw NEN 17294-2)	
	Zn-plant available	100	µg Zn/kg	Em: CCL3 (Gw NEN 17294-2)	
	Mn-plant available	< 250	µg Mn/kg	Em: CCL3 (Gw NEN 17294-2)	
	Cu-plant available	< 21	µg Cu/kg	Em: CCL3 (Gw NEN 17294-2)	Q
	Co-plant available	< 2,6	µg Co/kg	Em: CCL3 (Gw NEN 17294-2)	Q
	B-plant available	88	µg B/kg	Em: CCL3 (Gw NEN 17294-2)	
	Mo-plant available	< 4	µg Mo/kg	Em: CCL3 (Gw NEN 17294-2)	
	Se-plant available	< 2,1	µg Se/kg	Em: CCL3 (Gw NEN 17294-2)	
	Acidity (pH)	5,9		Em: NIRS	
	C-organic	0,6	%	Em: NIRS	Q
	Organic matter	0,7	%	Em: NIRS	Q
	C-inorganic	< 0,03	%	Em: NIRS	
	Carbonate lime	< 0,3	%	Em: NIRS	
	Clay (<2 µm)	3	%	Em: NIRS	
	Silt (2-50 µm)	8	%	Em: NIRS	
	Sand (>50 µm)	88	%	Em: NIRS	
	Clay-humus (CEC)	30	mmol+/kg	Em: NIRS	
	Electric Conductivity	0,29	mS/cm 25°C	Em: NIRS	
	Microbial biomass	15	mg C/kg	Em: NIRS	
	Microbial activity	20	mg N/kg	Em: NIRS	
	Fungal biomass	< 5	mg C/kg	Em: NIRS	
	Bacterial biomass	11	mg C/kg	Em: NIRS	
	Bulk density	1391	kg/m^3	Em: NIRS	

The values stated on page 1 and 2 under 'Result' are calculated from the above mentioned analysis results.

Q Method accredited by RvA
Em: Method Eurofins Agro, Gw: Equivalent of, Cf: In conformity with

Results are reported in dry soil.
The analyses were done at Eurofins Agro, Wageningen (NL).
The results relate exclusively to the material supplied, which Eurofins Agro received and was processed on 28-09-2022, and therefore to the sample analysed. For a detailed description of the sampling and analysis methods used, visit www.eurofins-agro.com

FertilizationManager

2K

Your client number is: 8240159

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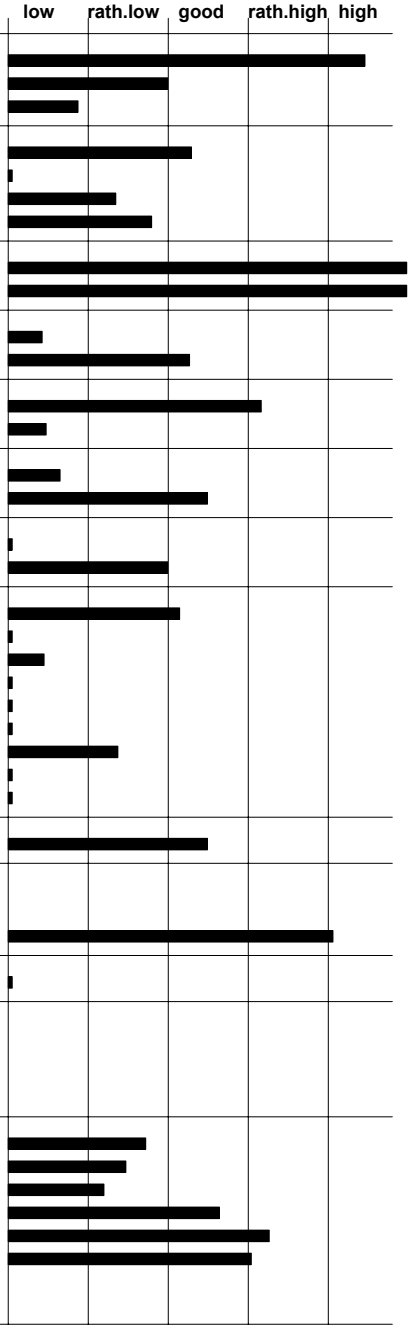
I www.eurofins-agro.com

Analysis | Investigation/ordernr: 801751/005854579 | Date sampling: 27-09-2022 | Date report: 19-10-2022

Results		Unit	Result	Target value
Chemical	Total N stock	kg N/ha	1360	780 - 1170
	C/N ratio		13	13 - 17
	N-supplying capacity	kg N/ha	35	95 - 145
	S-plant available	kg S/ha	23	20 - 30
	Total S stock	kg S/ha	< 525	170 - 320
	C/S ratio		34	50 - 75
	S-supplying capacity	kg S/ha	18	20 - 30
	P-plant available	kg P/ha	37,0	6,3 - 10,5
	P-soil stock	kg P/ha	1905	535 - 685
	K-plant available	kg K/ha	65	245 - 385
	K-soil stock	kg K/ha	300	250 - 420
	Ca-plant available	kg Ca/ha	670	250 - 585
	Ca-soil stock	kg Ca/ha	2170	2750 - 3505
	Mg-plant available	kg Mg/ha	120	245 - 385
	Mg-soil stock	kg Mg/ha	155	125 - 190
	Na-plant available	kg Na/ha	< 21	52 - 105
	Na-soil stock	kg Na/ha	56	56 - 104
	Si-plant available	g Si/ha	31930	20940 - 90740
	Fe-plant available	g Fe/ha	< 7010	8730 - 15710
	Zn-plant available	g Zn/ha	380	1750 - 2620
	Mn-plant available	g Mn/ha	< 870	3490 - 4540
	Cu-plant available	g Cu/ha	< 75	140 - 225
	Co-plant available	g Co/ha	< 10	15 - 30
	B-plant available	g B/ha	440	560 - 770
	Mo-plant available	g Mo/ha	< 10	350 - 17450
	Se-plant available	g Se/ha	< 7,4	12 - 16
Physical	Acidity (pH)		7,4	> 5,7
	C-organic	%	0,5	
	Organic matter	%	0,7	
	SOC/SOM ratio		0,71	0,45 - 0,55
	Carbonate lime	%	< 0,3	2,0 - 3,0
	Clay (<2 µm)	%	3	
	Silt (2-50 µm)	%	4	
	Sand (>50 µm)	%	92	
	<16 µm	%	4	
	Clay-humus (CEC)	mmol+/kg	43	> 44
	CEC-saturation	%	87	> 95
	Ca-saturation	%	72	80 - 90
	Mg-saturation	%	8,6	6,0 - 10
	K-saturation	%	5,1	2,0 - 4,0
	Na-saturation	%	1,6	1,0 - 1,5
	H-saturation	%	< 0,1	< 1,0
	Al-saturation	%	< 0,1	< 1,0



TESTEN RvA L 122

Results

	Unit	Result	Target value	low	rath.low	good	rath.high	high
Electric Conductivity	mS/cm 25°C	0,43	0,60 - 1,2					

	Unit	Result	Target value	low	rath.low	good	very good
Soil crumbling	score	10,0	6,0 - 8,0				
Soil slaking	score	7,1	6,0 - 8,0				
Risk on wind erosion	score	4,5	6,0 - 8,0				

Biological

	Unit	Result	Target value	low	rath.low	good	rath.high	high
Moisture retention cap.	mm	31						
Microbial biomass	mg C/kg	72	35 - 105					
Microbial activity	mg N/kg	20	8 - 13					
Fungal/bacterial ratio		0,3	0,6 - 0,9					

Fertilisation recommendations
The result is compared with an agricultural target value and is categorized as low, rather low, good, rather high high. This is not an appreciation as meant in ISO 17025 (par. 7.8.6).
Legislation
The fertilisation recommendations aim to achieve an agronomical optimum yield and crop quality. The recommendations do not take any legal restrictions into consideration.

Recommend.

	Recommendation	Unit
Soil based recommendation		
Phosphate (P_2O_5)	0	kg/ha
Potassium (K_2O)	0	kg/ha
Calcium (CaO)	545	kg/ha
Magnesium (MgO)	0	kg/ha
Lime (nw)	0	kg/ha
Effective OM	1000	kg/ha

When recommendations are high, it is adviced to split the amount during the 4 years, for instance supply half the amount biannially. The soil based recommendation is meant to level the soil stocks of phosphorus, potassium, calcium and magnesium to the required amounts.

The lime gift is based on an optimal pH of 6,0
The amount of effective organic matter needed is calcutated for a 4 year period. At the organic matter balance the yearly application of organic matter is calculated.

Recommend.		Crop	Culture	Recommendation
	Crop based recommendation (annual)			
in kg/ha	Nitrogen (N)	Ware potatoes		244
		Spring-sown onions		96
		Cabbage		176
		Onion sets	First year	80
		Summer carrots		80
	Sulphate (SO_3)	Ware potatoes		5
		Spring-sown onions		8
		Cabbage		95
		Onion sets	First year	0
		Summer carrots		133
	Phosphate (P_2O_5)	Ware potatoes		0
		Spring-sown onions		0
		Cabbage		0
		Onion sets	First year	0
		Summer carrots		0
	Potassium (K_2O)	Ware potatoes		330
		Spring-sown onions		115
		Cabbage		65
		Onion sets	First year	65
		Summer carrots		65
	Calcium (CaO)	Ware potatoes		80
		Spring-sown onions		125
		Cabbage		155
		Onion sets	First year	75
		Summer carrots		65
	Magnesium (MgO)	Ware potatoes		20
		Spring-sown onions		0
		Cabbage		0
		Onion sets	First year	0
		Summer carrots		0
	Sodium (Na_2O)	Ware potatoes		
		Spring-sown onions		
		Cabbage		
		Onion sets	First year	
		Summer carrots		
	Zinc (Zn)	Ware potatoes		0,5
		Spring-sown onions		1,0
		Cabbage		0,5
		Onion sets	First year	0,5
		Summer carrots		0,5
	Manganese (Mn)	-		See the explanation.
	Copper (Cu)	Ware potatoes		0,25
		Spring-sown onions		0,25
		Cabbage		0,25
		Onion sets	First year	0,25
		Summer carrots		0,25
	Boron (B)	Ware potatoes		0
		Spring-sown onions		0
		Cabbage		0
		Onion sets	First year	0
		Summer carrots		0,8

Crop based recommendation
The crop based recommendation is based upon the crop needs, average yields and climatic conditions and is corrected for soil nutrient stocks and the soil supplying capacity. If possible you can split the recommencation in several doses during the culture. During the growing season the SoilCropMonitor can be used for fertilization adjustments.

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The crop based fertilization will feed the crop and improve its quality. Due to higher/lower yields and possible losses (e.g leaching) the amount of plant available nutrients can fluctuate. Therefore, we advise you to carry out a crop based analyis (Culture analysis) to determine the actual amount of available nutrients and to update the fertilization recommendations.

Look carefully at the appreciation of the nutrients on page 1. If the target values indicate that one or more nutrient quantities are very low, consult your advisor to level these quantities.

We have assumed the following yields, when calculating the crop based recommendations:

Ware potatoes	47,0
Spring-sown onions	49,0
Cabbage	40,0
Onion sets	25,0
Summer carrots	-

When your yield differentiates from the above, it is recommended to adjust your fertilization accordingly

Nitrogen:
The N recommendation relates to an annual dose. If possible, we recommend splitting this N dose into several applications. You can use our SoilCheck soil test in season to determine whether subsequent applications are necessary. This test measures the plant-available N (mineral N) in the soil among other things.

Sulphur:
Sulphur (S) is released by the degradation (mineralisation) of organic matter or manure. This mineralisation is performed by soil organisms. Soil organisms are not very active under colder conditions, which means not much S is released from the soil early in the spring. Therefore, it is sensible to fertilise with S for many early crops, even if the soil content is good or high.

Phosphate:
P-supplying capacity is 12 . The target range is 17 - 27
The P-buffering capacity indicates whether the P-soil stock is high enough to maintain the level of plant available P. When the buffering capacity (buffering power) is low, the plant available P will not remain on level during the growing season: it will decrease.

Potassium:

Calcium:
Fertilization with calcium may benefit the soil structure.

Manganese:
Manganese deficiency is to be expected.
During periods of rapid growth, please apply foliar fertilizers containing Manganese.

Clay-humus (CEC):
You can increase the CEC by applying organic matter and/or increase the pH of your soil.

Soil life:
The biological soil fertility is measured by 3 characteristics, the microbial biomass, the microbial activity, and the fungal/bacterial ratio.
The acknowledgement of the measured results is based upon the amount of organic matter. There is not a recommendation given for the measured characteristics. On the basis of research projects there will be more information available.

Organic matter

Figure: Organic matter balance

Yearly breakdown rate (percentage) of the total organic matter content (%): 3,7

- Stock of organic matter which will remain after 1 year in the sampled layer if no (effective) organic matter is supplied.
- Total required supply of effective organic matter as a result of the degradation of the organic matter.
- Supply through crop residues (average within provided rotation scheme or crops).
- Remaining to be supplied through e.g. animal manure, green manures and/or compost.

Crop (residue)	Culture:	Input of effective organic matter
Ware potatoes		875
Spring-sown onions		300
Cabbage		1150
Onion sets	First year	300
Summer carrots		700

Average input/year		665

For increasing the soil organic matter content by 0.1%: 3490 kg effective organic matter per hectare is needed.

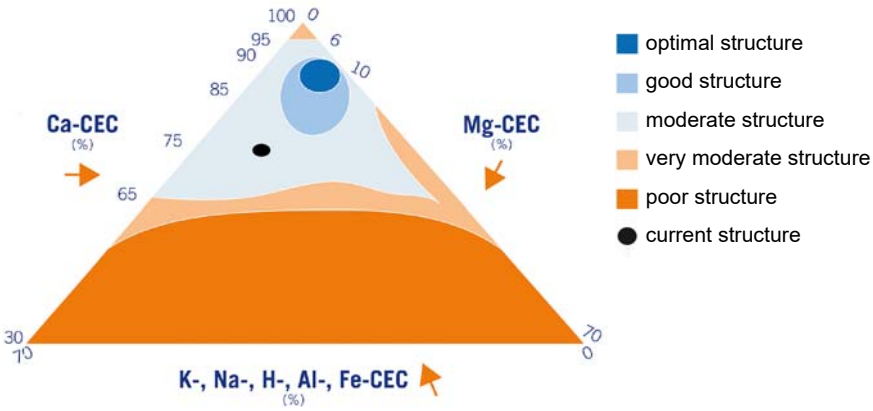
Figure: Quality of the organic matter

Organic matter consists primarily of C, N, P, S. If the organic matter contains relatively high amounts of N and/or S, this makes it attractive to soil organisms. Soil organisms happily eat this organic matter. N and S are released in the process and the amount of organic matter decreases slightly (dynamic organic matter). Organic matter can also contain a lot of C. This is generally less attractive to soil organisms (bacteria). As a result, the organic matter is not consumed as quickly by the soil organisms; making the organic matter more stable. Stable organic matter contributes - among other factors - to the workability of the soil and the looseness. Dynamic organic matter contributes primarily to the release of N and S and is therefore a source of these nutrients for the crop. The quality of the organic matter can be changed (gradually) by paying attention to the properties of soil improvers such as animal manure, compost and crop residues.

Physical

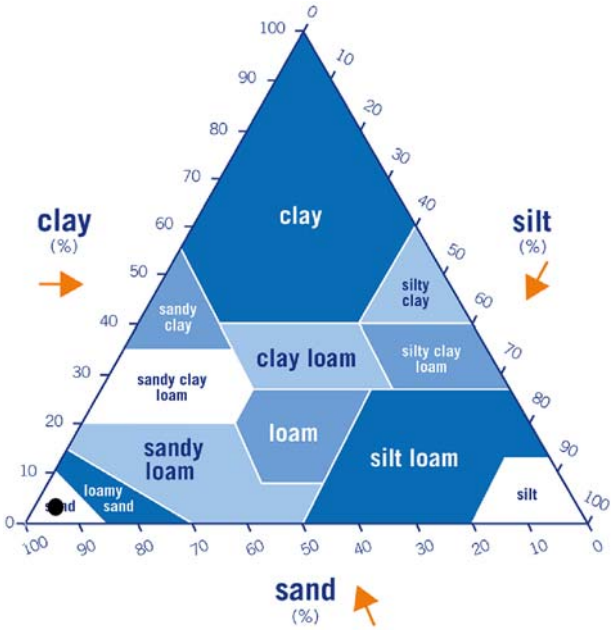
The assessment of soil structure is based on the Ca-CEC, K-CEC, and Mg-CEC ratio. Actual soil structure is - of course - not merely depending on ratio, but also on weather conditions, moisture condition of the soil, and the weight of the machinery.

Figure: Structure triangle



Physical

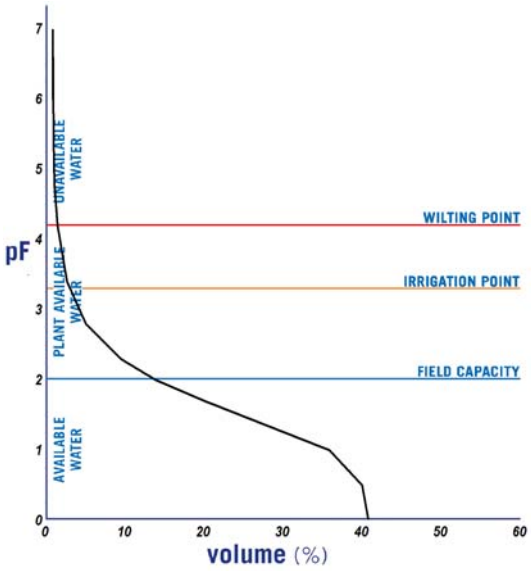
Figure: Texture triangle



Besides clay, the silt and sand fractions are presented as well. Clay is smaller than 2 micrometer (µm), silt particles are 2-50 µm and sand particles are larger than 50 µm. The relative distribution of soil particles is used to estimate the risk of slaking. Slaking causes the soil pores to be clogged with smaller particles and degrades soil structure. The risk of slaking is greatest at 10-20% clay.

Soil crumbling score is: good, however the evaluation of soil crumbling status is also depending on crop type.
Considering the results, the chance of soil slaking is small.

Figure: Water retention curve



The amount of plant available water in the sampled layer is 31 mm. This is the maximum amount you should irrigate. All excess irrigation will drain off the parcel or will sink to deeper layers.

Field capacity (pF 2,0):	14,0	% moisture
Irrigation point (pF 3,3):	3,1	% moistur e
Wilting point (pF 4,2):	1,6	% moistur e

Crops have difficulties to obtain water when the actual moisture level is below pF 3,3. When you are able to measure the moisture level, start with irrigation if the moisture content of the parcel is at 3,1 % and irrigate 27 mm.

The actual moisture level can be measured by using a soil moisture sensor, or collect soil from ten spots in the parcel. Measure the weight of the moist soil and the weight after 24 h drying. The difference between moist and dry soil is an indication of the moisture level of the parcel.

Contact & info

Soil layer:	0 - 25 cm
Sample was taken by:	Third party
Contact sample taking:	Alie Hissink: 0652561834

If the following information is shown in the reports, this information may have been provided by the client and may affect the valuation, advice and/or analysis result:
sampling depth, crop, culture.

2K

Method		Result	Unit	Method	RvA
Results analyses	Total nitrogen stock	390	mg N/kg	Em: NIRS	Q
	S-plant available	6,5	mg S/kg	Em: CCL3 (Gw NEN 17294-2)	
	Total sulphur stock	< 150	mg S/kg	Em: NIRS	Q
	P-plant available	10,6	mg P/kg	Em: CCL3 (Gw NEN 15923-1)	Q
	P-soil stock	125	mg P_2O_5/100 g	PAL1: Gw NEN 5793	Q
	P-soil stock	55	mg P/100 g	PAL1: Gw NEN 5793	Q
	K-plant available	18	mg K/kg	Em: CCL3 (Gw NEN 17294-2)	
	K-soil stock	2,2	mmol+/kg	Em: NIRS	
	Ca-plant available	2,4	mmol Ca/l	Em: NIRS	
	Ca-soil stock	31	mmol+/kg	Em: NIRS	
	Mg-plant available	34	mg Mg/kg	Em: CCL3 (Gw NEN 17294-2)	
	Mg-soil stock	3,7	mmol+/kg	Em: NIRS	
	Na-plant available	< 6	mg Na/kg	Em: CCL3 (Gw NEN 17294-2)	
	Na-soil stock	0,7	mmol+/kg	Em: NIRS	
	Si-plant available	9150	µg Si/kg	Em: CCL3 (Gw NEN 17294-2)	
	Fe-plant available	< 2010	µg Fe/kg	Em: CCL3 (Gw NEN 17294-2)	
	Zn-plant available	110	µg Zn/kg	Em: CCL3 (Gw NEN 17294-2)	
	Mn-plant available	< 250	µg Mn/kg	Em: CCL3 (Gw NEN 17294-2)	
	Cu-plant available	< 21	µg Cu/kg	Em: CCL3 (Gw NEN 17294-2)	Q
	Co-plant available	< 2,6	µg Co/kg	Em: CCL3 (Gw NEN 17294-2)	Q
	B-plant available	126	µg B/kg	Em: CCL3 (Gw NEN 17294-2)	
	Mo-plant available	< 4	µg Mo/kg	Em: CCL3 (Gw NEN 17294-2)	
	Se-plant available	< 2,1	µg Se/kg	Em: CCL3 (Gw NEN 17294-2)	
	Acidity (pH)	7,4		Em:PHC3(Cf NEN ISO 10390)	Q
	C-organic	0,5	%	Em: NIRS	Q
	Organic matter	0,7	%	GLV1: Gw NEN 5754	Q
	C-inorganic	< 0,03	%	Em: NIRS	
	Carbonate lime	< 0,3	%	Em: NIRS	
	Clay (<2 µm)	3	%	Em: NIRS	
	Silt (2-50 µm)	4	%	Em: NIRS	
	Sand (>50 µm)	92	%	Em: NIRS	
	Clay-humus (CEC)	43	mmol+/kg	Em: NIRS	
	Electric Conductivity	0,43	mS/cm 25°C	Em: NIRS	
	Microbial biomass	72	mg C/kg	Em: NIRS	
	Microbial activity	20	mg N/kg	Em: NIRS	
	Fungal biomass	8	mg C/kg	Em: NIRS	
	Bacterial biomass	27	mg C/kg	Em: NIRS	
	Bulk density	1396	kg/m^3	Em: NIRS	

The values stated on page 1 and 2 under 'Result' are calculated from the above mentioned analysis results.

Q Method accredited by RvA
Em: Method Eurofins Agro, Gw: Equivalent of, Cf: In conformity with

Results are reported in dry soil.
The analyses were done at Eurofins Agro, Wageningen (NL).
The results relate exclusively to the material supplied, which Eurofins Agro received and was processed on 28-09-2022, and therefore to the sample analysed. For a detailed description of the sampling and analysis methods used, visit www.eurofins-agro.com

Test for fertilization
basic water + total-Fe
1K

Your client number is: 8240159

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Sample

Research-/ordernumber:	Date sampling:	Date report:	Code of object:
702023/005854071	22-09-2022	29-09-2022	02023
Test code:	**Receiving date:**	**Sample was taken by:**	**Contactperson sampling:**
612	27-09-2022	Third party	

Results

		analysis	guideline	converted results			analysis	guideline	Unit
	pH	7,4	5,5-7,5			Total hardness	68,9		°D
mS/cm 25°C	EC	4,1	<0,5			Temporary hardness	11,5		°D
Cations mmol/l	NH_4	< 0,1	<0,3	< 1,9	ppm				
	K	0,6	<1,0	23	ppm				
	Na	18,3	<1,5	421	ppm				
	Ca	10,7	<1,0	429	ppm				
	Mg	1,6	<1,0	39	ppm				
Anions mmol/l	NO_3	0,3	<2,0	19	ppm				
	Cl	27,7	<1,5	982	ppm				
	S	5,6	<1,0	180	ppm				
	HCO_3	4,1	<3,0	250	ppm				
	P	< 0,04	<0,20	< 1,3	ppm				
Micro-nutrients µmol/l	Fe	0,4	<10	22	ppb				
	Mn	0,3	<3	16	ppb				
	Zn	0,3	<2	20	ppb				
	B	18	<10	195	ppb				
	Cu	< 0,1	<1,0	< 6,4	ppb				
	Mo	0,2	<0,8	19	ppb				
mmol/l	Si	0,19	<1,5	5,3	ppm				
µmol/l	Fe-tot	0,6	<10	34	ppb				

Converted results: ppm = mg/l and ppb = µg/l.

The advice given in this report provides general guidelines for the fertiliser application (stated at the end of the report). Depending on the type of crop, growth stage and growth circumstances, the guidelines may vary slightly.

1K

Crop data

Source
Use Hydroponics
Irrigation system

History	pH	EC mS/cm	NH_4 mmol/l	K	Na	Ca	Mg	NO_3	Cl	S	HCO_3	P	Si	Fe µmol/l	Mn	Zn	B	Cu	Mo
27-09-22	7,4	4,1	< 0,1	0,6	18,3	10,7	1,6	0,3	27,7	5,6	4,1	< 0,04	0,19	0,4	0,3	0,3	18	< 0,1	0,2

Method

If the following information is shown on the reports, this information has been provided by the customer: crop, cultivation type, cultivation method, cultivation stage, cultivation medium, watering system, cultivation system, fertilization system, A and B container contents, fertilizer package, drip EC, used drain sample for recirculation incl. recirculation EC or %, type of material/soil, used basic water, type of water, application (purpose) water.

pH		Em: PH-GTB
EC	Q	Em: FILTR en EC1
NH_4	Q	Em: FILTR en SFAHFD
NO_3	Q	Em: FILTR en SFAHFD
Cl	Q	Em: FILTR en SFAHFD
HCO_3	Q	Em: FILTR en SFAHFD
Remaining analyses	Q	Em: FILTR en ICP-HSP
Fe-tot	*	Em: ICP-HSP

Q Method accredited by RvA
Em: Method Eurofins Agro, Gw: Equivalent of, Cf: In conformity with
* For this procedure the maximum shelf life between sampling and analysis has been exceeded.
This may have affected the reliability of the result.

The results relate exclusively to the material supplied, which Eurofins Agro received and was processed on 27-09-2022, and therefore to the sample analysed. For a detailed description of the sampling and analysis methods used, visit www.eurofins-agro.com
All analyses were (partial) conducted at the laboratory in Eurofins Agro, Wageningen.

Test for fertilization
basic water + total-Fe
2K

Your client number is: 8240159

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Sample

Research-/ordernumber:	Date sampling:	Date report:	Code of object:
702024/005854071	22-09-2022	28-09-2022	02024
Test code:	**Receiving date:**	**Sample was taken by:**	**Contactperson sampling:**
612	27-09-2022	Third party	

Results

		analysis	guideline	converted results			analysis	guideline	Unit
	pH	7,6	5,5-7,5			Total hardness	39,8		°D
mS/cm 25°C	EC	1,5	<0,5			Temporary hardness	5,9		°D
Cations mmol/l	NH_4	< 0,1	<0,3	< 1,9	ppm				
	K	0,2	<1,0	7,8	ppm				
	Na	2,6	<1,5	60	ppm				
	Ca	6,2	<1,0	248	ppm				
	Mg	0,9	<1,0	22	ppm				
Anions mmol/l	NO_3	0,1	<2,0	6,2	ppm				
	Cl	3,3	<1,5	117	ppm				
	S	5,7	<1,0	183	ppm				
	HCO_3	2,1	<3,0	128	ppm				
	P	< 0,04	<0,20	< 1,3	ppm				
Micro-nutrients µmol/l	Fe	< 0,2	<10	< 12	ppb				
	Mn	< 0,1	<3	< 5,5	ppb				
	Zn	0,5	<2	33	ppb				
	B	7,6	<10	82	ppb				
	Cu	< 0,1	<1,0	< 6,4	ppb				
	Mo	0,2	<0,8	19	ppb				
mmol/l	Si	0,18	<1,5	5,1	ppm				
µmol/l	Fe-tot	0,7	<10	39	ppb				

Converted results: ppm = mg/l and ppb = µg/l.

2K

Results The advice given in this report provides general guidelines for the fertiliser application (stated at the end of the report). Depending on the type of crop, growth stage and growth circumstances, the guidelines may vary slightly.
The specific feeding schedule per crop is shown on the analysis report of the drain water, substrate or soil.

Recommend. Fertilizers can be added according to scheme B 3.23.2.22.0.0.
The above water schedule has been calculated on the basis of the analysed parameters, and is shown in the following sequence: B HCO_3.Ca.Mg.S.NO_3.K
When using this fertiliser recommendation schedule, a correction is made to these elements. The bicarbonate content determines the amount of acid that must be added to neutralise this.
If trace elements are present in the water, a correction is also made to the recommendation. The size of the correction is shown in the drain water or substrate analysis report.

Crop data

Source	
Use	Hydroponics
Irrigation system	

History	pH	EC mS/cm	NH_4 mmol/l	K	Na	Ca	Mg	NO_3	Cl	S	HCO_3	P	Si	Fe µmol/l	Mn	Zn	B	Cu	Mo
27-09-22	7,6	1,5	< 0,1	0,2	2,6	6,2	0,9	0,1	3,3	5,7	2,1	< 0,04	0,18	< 0,2	< 0,1	0,5	7,6	< 0,1	0,2

Method

If the following information is shown on the reports, this information has been provided by the customer: crop, cultivation type, cultivation method, cultivation stage, cultivation medium, watering system, cultivation system, fertilization system, A and B container contents, fertilizer package, drip EC, used drain sample for recirculation incl. recirculation EC or %, type of material/soil, used basic water, type of water, application (purpose) water.

pH		Em: PH-GTB
EC	Q	Em: FILTR en EC1
NH_4	Q	Em: FILTR en SFAHFD
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HCO_3	Q	Em: FILTR en SFAHFD
Remaining analyses	Q	Em: FILTR en ICP-HSP
Fe-tot	*	Em: ICP-HSP

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