

Hydroponic Vertical Farming:

Developing VET for addressing vertical hydroponic farming skill needs

Hydro-Farm-VET

R.2.3: Slovenian National report (QUESTIONNAIRES- INTERVIEWS)



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1. Slovenian National report

1.1 Brief Review

This national report is part of outcome R_23 “Five(5) National Reports as needs assessment to determine the gap or discrepancy between the present state and the desired state in the hydroponic field”.

The data presented in the report consists of two main activities:

- A. collection of information through questionnaires
- B. collection of information through Key Informant Interviews with 3 agricultural specialists per country

Below is the analysis of data collected from the questionnaires distributed and the conducted interviews to develop the R_2.3 “Five(5) National Reports as needs assessment to determine the gap or discrepancy between the present state and the desired state in the hydroponic field”.

Content

This report will present the results of questionnaire responses and interviews conducted with key informants in the field of hydroponics and vertical hydroponics.

Section 1.2 presents the results of the data from the questionnaires and in section 1.3 the information in aggregate from the key informant interviews, and section 1.4 for the comparison of the information and conclusions.

1.2 Presentation and analysis of questionnaires

This section reports the analysis of 18 questionnaire responses collected between mid-June and mid-July 2023, in Slovenia. Questionnaires were sent out to selected stakeholders via the online platform

Google Forms. The objective was to collect information about the country's hydroponic situation and assess skill gaps and training needs in vertical hydroponic agriculture.

Questionnaire

The questionnaire consists of six main sections:

1. Section_1, information on data collection and processing
2. Section_2, type of participant
3. Section_3, about the respondents' experience with hydroponic and vertical hydroponic farming (e.g. whether they have hydroponics systems, the size of their systems, whether they have attended courses in this field, etc.)
4. Section_4, with regard to their training needs in the areas of technological and agronomic knowledge.
5. Section_5 with regard to their training needs in the area of management knowledge
6. Section_6, for any comments on the questionnaire

Presentations of the results

Data presentation and results

Type of participant	Frequency	Percent [%]
Farmers	5	28
Hydroponic technology producers (e.g. LED, equipment, etc.)	2	11
Research (Researcher)	2	11
Consultants	5	28
Public institutions	3	17
Other	1	6
<i>Total</i>	<i>18</i>	<i>100</i>

Table 1: Type of participant

In table 1, we show the data of the participants to the questionnaires by frequency and percentage.

In figure 1, a graphic representation of data in table 1 is presented. As we can see from the graph in Figure 1, 28% of the respondents are farmers, 11% Hydroponic technology producers, 11% Researchers, 28% Consultants, and 6% Other identifying an Agronomist working in an hydroponic salad production farm.

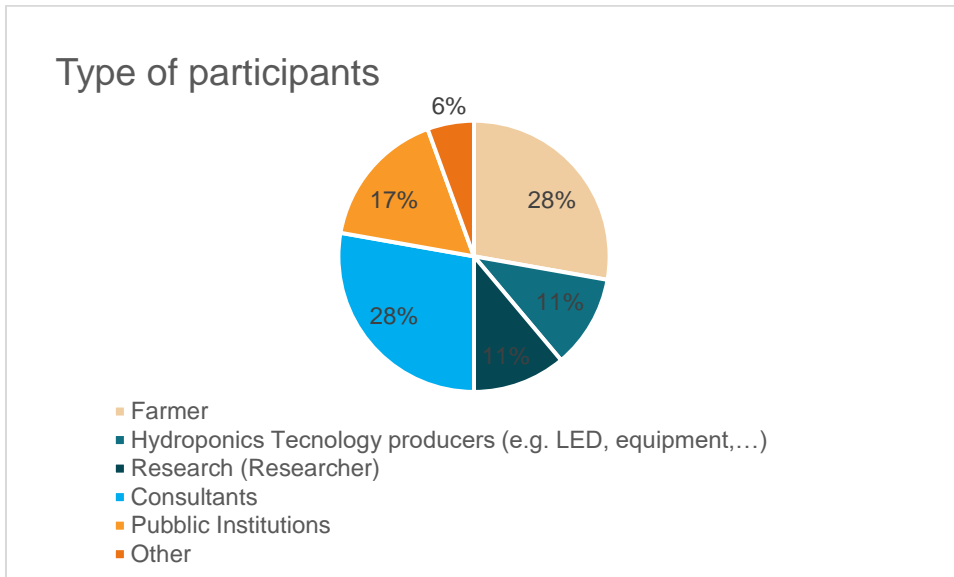


Figure 1: Type of participants

In table 2, we see the spread of the use of hydroponics technologies among the respondents

Use of hydroponics technology	Yes	No	Tot
I am already using hydroponics	39%	61%	100%
I am already using vertical hydroponics	22%	78%	100%

Table 2: Use of hydroponics technology

61% of the respondents answered that they are not using Hydroponics while 39% answered that they are already using this kind of cultivation technique.

78% of the respondents answered that they are not using Vertical Hydroponics while 22% answered that they are already using this kind of cultivation.

Table 3 shows the answers concerning the respondents' experience with hydroponics.

Specify your experience with hydroponics from 0 (none) to 5 (high experience)	Frequency	Percent [%]
0	0	0
1	3	17
2	4	22
3	4	22
4	2	11

5	5	28
<i>total</i>	<i>18</i>	<i>100</i>

Table 3: Specify your experience with hydroponics from (0) to 5 (high experience)

As we can see from table 3, 28% had excellent experience with Hydroponics (5 from a scale 0 to 5), 11% had a very good experience with Hydroponics (4 from scale 0 to 5), 22% had good experience with hydroponics (3 from scale 0 to 5), 22% had intermediate experience with hydroponics (2 from scale 0 to 5), 17% had entry level of experience with hydroponics (1 from scale 0 to 5), 0% had not at all experience with hydroponics (0 from scale 0 to 5).

Specify your experience with hydroponics from 0 (none) to 5 (high experience)	Value
Average	3,11
Standard Deviation	1,45

Table 4: Specify your experience with hydroponics from 0 (none) to 5 (high experience) - Average and Standard Deviation

With regard to the hydroponic farming that the respondents possess in m², five (5) respondents seem to possess structure as follows:

- 1.2 m²
- 10.000 m²
- 300 m²
- 20.000 m²

With regard to the dimension of vertical hydroponic farming respondents mentioned that they possess the following structure in m²:

- 1 m²
- 3 m²
- 100 m²

With regard to the dimension of the farm, respondents mentioned the following dimension of in ha:

- 1 m²
- 2 m²
- 3 m²
- 4 m²
- 9 m²
- 10 m²
- 14 m²
- 470 m²

- 3400 m²

Table 5, on the other hand, describes the percentage of respondents who have attended courses in hydroponics or vertical hydroponics farming.

Courses	Yes	No	Tot
Did you attend courses on hydroponics? * by mistake when transcribing the questionnaire, I entered the second question twice	//	//	//
Did you attend courses on vertical hydroponics?	22%	78%	100%

Table 5: Attendance of courses on hydroponics

With regard to the attendance of Vertical Hydroponic courses 4 respondents answered that they have attended Vertical Hydroponic courses for 22% of the total and 14 that they did not attend for 78% of the total.

In qualitative terms, we also gathered information on the main products. Most respondents answered that they grow vegetables (strawberries, tomatoes, lettuce,...) and the second most common answer was technical equipment and fertilisers.

The participants came from the following regions

- 1 from Goriška region
- 3 from Gorenjska region
- 4 from Central Slovenia
- 1 from Podravska region
- 2 from Coast region
- 4 from Pomurska region
- 1 from posavje region

The last parts of the questionnaire concerned the determination of knowledge needs in different areas concerning hydroponics agriculture and vertical hydroponics farming. In particular, three main areas were considered, technological knowledge, agronomic knowledge and management knowledge. Asking in all three areas to indicate a value, from 1 (minimum) to 5 (maximum), of the training needs related to the listed items.

Table 6 shows the scores indicated by the respondents concerning training needs in the area of technological knowledge.

Technological knowledge		
Give a value, from 1 (minimum) to 5 (maximum) of the training needs regarding:		
General knowledge of hydroponics technologies	Frequency	Percent [%]
1	0	0
2	4	22
3	4	22
4	3	17
5	7	39
total	18	100
General knowledge of LED lights and energy efficiency	Frequency	Percent [%]
1	1	6
2	3	17
3	4	22
4	4	22
5	6	33
total	18	100
Hydraulic functioning and management	Frequency	Percent [%]
1	1	6
2	3	17
3	4	22
4	4	22
5	6	33
total	18	100
System automation	Frequency	Percent [%]
1	1	6
2	2	11
3	5	28
4	3	17
5	7	39
total	18	100

Table 6: Technological Knowledge

The results show us that the need for knowledge of hydroponics, LED lighting and energy efficiency, hydraulic operation and management, and system automation is highly desirable, with about 30% of the

respondents, about 20% of the respondents identifying this need with a score of 4, and about 20% of the respondents identifying the need for the skills with a score of 3.

Table 7 shows the value of the average and standard deviation associated to each area, as we can see with regard to the training needs on technological knowledge, the voices General Knowledge of hydroponics technologies and System automation gained the highest scores.

See below:

Technological Knowledge	General knowledge of hydroponics technologies	General knowledge of LED lights and energy efficiency	Hydraulic functioning and management	System automation
Average	3,72	3,61	3,56	3,72
Standard Deviation	1,19	1,25	1,30	1,24

Table 7: Technological Knowledge - synthesis

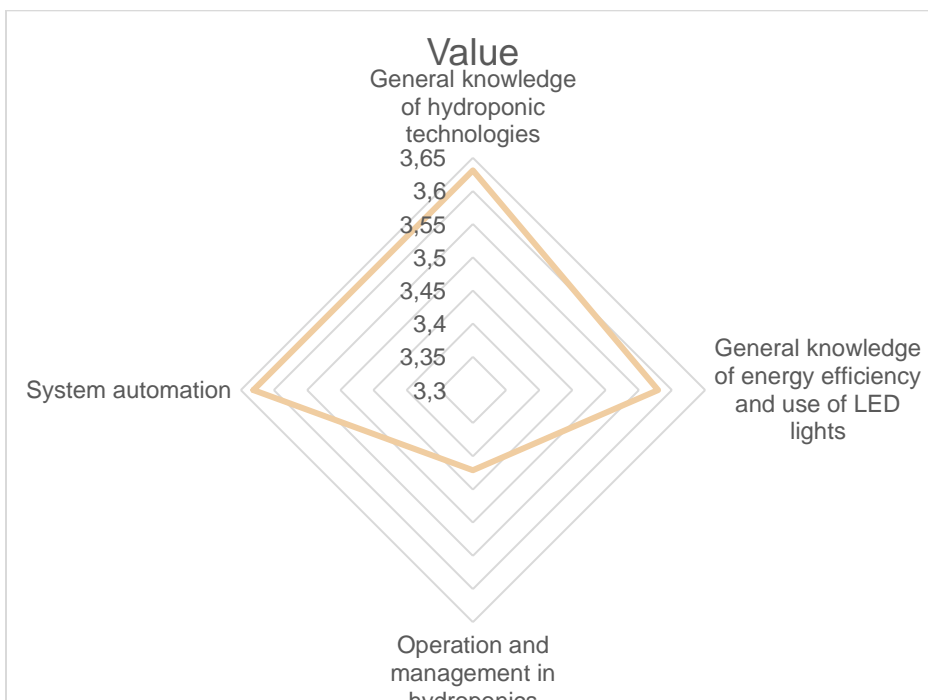


Figure 2: Technological Knowledge

In Figure 2, we can see the graphic representation of the values reported in table 7.

Table 8 illustrates the frequency and the relative percentage indicated by the respondents concerning training needs in the area of agronomic knowledge.

Agronomic knowledge		
Give a value, from 1 (minimum) to 5 (maximum) of the training needs regarding:		
Substrata to be utilized		Percent [%]
	Frequency	
1	1	6
2	2	11
3	4	22
4	6	33
5	5	28
total	18	100
Composition of the nutritive solution		Percent [%]
	Frequency	
1	0	0
2	2	11
3	2	11
4	4	22
5	10	56
total	18	100
Integration of minerals		Percent [%]
	Frequency	
1	0	0
2	3	17
3	1	6
4	5	28
5	9	50
total	18	100
Crop types		Percent [%]
	Frequency	
1	0	0
2	2	11
3	5	28
4	6	33
5	5	28
total	18	100
Pathogens, fungi, and parasites of soilless crops. Diagnostic elements		Percent [%]
	Frequency	
1	0	0

	2	2	11
	3	5	28
	4	4	28
	5	7	33
total		18	100
Pathogens, fungi, and parasites of soilless crops. Defense strategies		Frequency	Percent [%]
	1	0	0
	2	2	11
	3	5	28
	4	5	28
	5	6	33
total		18	100

Table 8: Agronomic Knowledge

Table 9 shows the value of the average and standard deviation associated to each area, as we can see with regard to the training needs on agronomic knowledge almost the voice Composite of the nutritive solution obtained the highest value.

See below:

Agronomic knowledge	Substrata to be utilized	Composition of the nutritive solution	Integration of minerals
Average	3,67	4,22	4,11
Standard Deviation	1,15	1,03	1,10
Agronomic knowledge	Crop types	Pathogens, fungi, and parasites of soilless crops. Diagnostic elements	Pathogens, fungi, and parasites of soilless crops. Defense strategies
Average	3,78	3,89	3,83
Standard Deviation	0,97	1,05	1,01

Table 9: Agronomic knowledge - Synthesis

In Figure 3, we can see the graphic representation of the values reported in table 9.

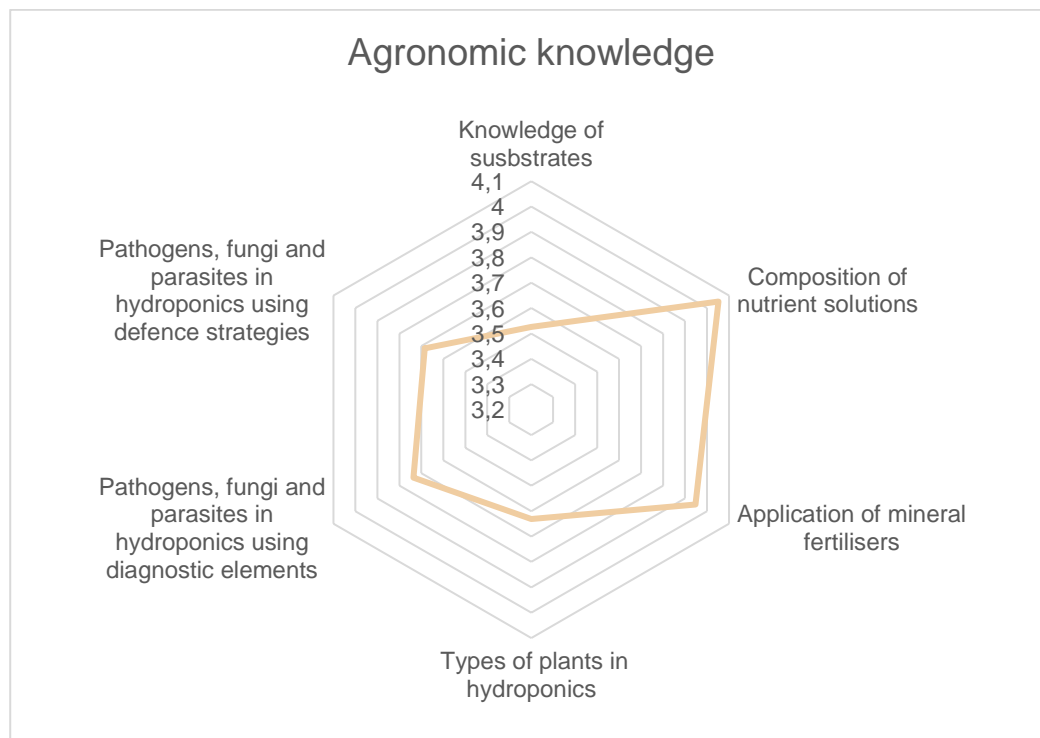


Figure 3: Agronomic knowledge

Table 10 illustrates the frequency and the relative percentage indicated by the respondents concerning training needs in the area of Management knowledge.

Management knowledge			
Give a value, from 1 (minimum) to 5 (maximum) of the training needs regarding:			
Cost analysis and business planning		Frequency	Percent [%]
	1	2	11
2	3	17	
3	3	17	
4	5	28	
5	5	28	
total		18	100
Funding opportunities		Frequency	Percent [%]
	1	3	17
2	2	11	
3	4	22	
4	3	17	
5	6	33	

total		18	100
Communication and visibility		Frequency	Percent [%]
	1	1	6
	2	3	17
	3	4	22
	4	4	22
	5	6	33
total		18	100
Access to market		Frequency	Percent [%]
	1	4	22
	2	2	11
	3	2	11
	4	4	22
	5	6	33
total		18	100

Table 10: Management Knowledge

Table 9 shows the value of the average and standard deviation associated to each area, as we can see with regard to the training needs on Management knowledge almost all topics were ranging as an average score between 3,30 to 3,61 with the thematic of Communication and Visibility gaining the maximum score and the communication and visibility the minimum score.

See below:

Management knowledge	Cost analysis and business planning	Funding opportunities	Communication and visibility	Access to market
Average	3,44	3,39	3,61	3,33
Standard Deviation	1,34	1,46	1,25	1,56

Table 11: Management knowledge - synthesis

In Figure 4, we can see the graphic representation of the values reported in table 11.

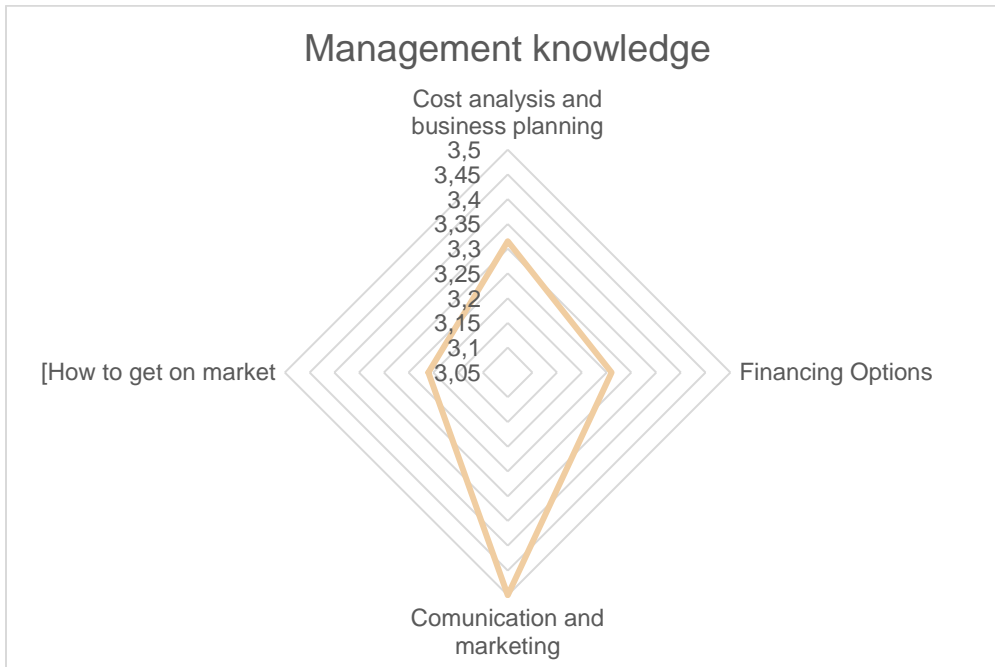


Figure 4: Management Knowledge

1.3 Presentation and analysis of key Informant Interviews with 3 agricultural specialists per country

Key informant interviews were conducted with 3 experts in the field of hydroponics.

Key Informant interviews

The interviews lasted between 20 and 45 minutes and covered the following questions:

1. What are the main knowledge barriers (e.g. lack of training courses, overpriced training courses, etc.) to developing vertical hydroponics in the country?
2. Which are the main courses and experiences to be used as an example in the country?
3. General comment on the first results of the questionnaire (e.g. by listing, and presenting the main training needs highlighted by the questionnaire, if the knowledge gap can be addressed by existing courses/ initiatives in the country or not).
4. Their opinion of actual knowledge gap
5. From your experience which professional figures are most sought after by vertical/hydroponics farming companies?

Presentation of the results

Data presentation and results

The Key informant interviews were:

n	Profession
1	Sales manager in an hydroponic sistem (Lettuce production)
2	Project manager in ad Hydroponic farms (strawberry production)
3	Head of research and experimentation centre - Institute of agriculture of Slovenia (areas of works: Hydroponic, robotics and automation)

The information obtained from the interviews will be presented below in aggregate and divided by question.

1. *What are the main knowledge barriers (e.g. lack of training courses, overpriced training courses, etc.) to developing vertical hydroponics in the country?*

Two interviewees point out that technology plays a very important role in this sector and that it is much more advanced than the knowledge taught in schools and those who work as horticulturists.

Furthermore, one interviewee adds the importance of the population's awareness of the benefits of this type of production and the consequent and necessary political support for choosing this type of production to increase self-sufficiency.

Another interviewee points out that the main problem is the lack of infrastructure and equipment where the profession can be trained to pass on knowledge and experience to the interested public. Stressing that there are no suitable facilities for this type of activity.

2. *Which are the main courses and experiences to be used as an example in the country?*

All respondents point out that they do not know of any courses in this field in Slovenia. One respondent says that he works with the Faculty of Biotechnology in Ljubljana, and another adds that perhaps there are some courses at this faculty.

One respondent points out that the courses available in this field are only abroad, for example, at Wageningen University.

- 3. General comment on the first results of the questionnaire (e.g. by listing, and presenting the main training needs highlighted by the questionnaire, if the knowledge gap can be addressed by existing courses/ initiatives in the country or not).*

One interviewee points out that the sector is below the EU average. He points out that companies producing finished products with hydroponics have a lot of knowledge, which they improve with the help of so-called 'flying consultants' who visit them occasionally. The training of the technicians of these companies mainly takes place abroad (Netherlands, Denmark, France).

Another interviewee points out that many professions are needed for hydroponic development and production, from mechanical engineers to electrical engineers, economists to agronomists to production workers. Furthermore, he believes that more support from the state through investments and co-financing is important.

Another interviewee also highlights the professions needed in this sector, including technical skills, mechanical and electrical engineering, biology and agronomy. Current and future growers turn to foreign consultancy companies, whose staff consists mainly of experienced growers. He adds that last year, the Slovenian Chamber of Commerce and Industry established an association of modern greenhouse growers, who should generally have the most knowledge in this field. The solution is an advisory service, e.g. within the Kmetijska Chambers or the Chamber of Commerce, separate from other advisory services because it is more concerned with its branch of the economy or so-called modern agriculture.

4. Their opinion on actual Knowledge gap

The interviewees agree that general knowledge about hydroponics in Slovenia is not very widespread. One respondent specifies that knowledge in this field among growers is not good because there are no specific courses apart from consultations at various meetings and events (e.g. the AGRA fair). Furthermore, the professors themselves admit that they do not have sufficient knowledge to train future hydroponics technologists adequately. This is why they offer guided tours to students in their plant.

Another interviewee points out how important it is first to create a knowledge generation system, which can only be achieved with the right equipment (greenhouses and plants) but which is not present at the

moment, and consequently, there are no experts in this field. He emphasises how technology in the field of hydroponics is advancing so fast that it is impossible to keep up without a serious programme. In his opinion, educational institutions will have to train agricultural advisors, who will pass on the knowledge to farmers. There will be a need for biologists, physiologists, agronomists, computer scientists and mechanical engineers.

One respondent emphasises that general knowledge in Slovenia is limited to a few theories and practices of farms/companies engaged in this field, pointing out that there is much room for improvement. In particular, by informing a wider population, this production could be brought closer to the people. In fact, another respondent says that with regard to hydroponics, today, there is a problem with consumers who still have an aversion to hydroponically grown vegetables.

5. From your experience which figures are most sought after by hydroponic farming companies?

In this question, respondents expressed their opinion on what hydroponics farming companies most require information.

Information on climate, nutrients needed, possible investors, subsidies, financial support, crops to be grown and their production costs, and Return on Investment (ROI) was highlighted. In addition, information on production technology and where to find technical and advisory personnel in these areas.

A respondent working in the field of strawberries in hydroponics specifies that they are looking for detailed information on the response of different varieties to this type of production, the response of varieties to the type of substrate chosen by the grower, the adaptation of dosing methods according to the stage of the plant, measures to be taken in case of disease problems, highlighting how a very large sector of plant protection is moving towards a strong reduction in the use of chemicals and an increase in the use of natural products

1.4 Comparison of the information and conclusions

Comparison of the information and conclusions

According to the survey we found that it is very difficult to get farmers in Slovenia who are involved in hydroponics. As far as vertical hydroponics is concerned, there is very little representation in Slovenia. Small experiments were made, but farmers soon stop doing it, as the investment was too high according to the cost calculation or the product was uncompetitive (too high a price of product). In our surveys, the respondents answered mostly in terms of general hydroponic plant cultivation. The percentage of respondents with experience in vertical hydroponics is only 28%. When asked how much is the surface area of their hydroponics, 3 respondents answered this question and the largest surface area of vertical hydroponics is 100m³. That means, we have really small surface to do hydroponics. Also regarding the training courses that the respondents have attended, regarding vertical hydroponics, there are very few, only 22% of the respondents. The reason for this can be seen from the interviews, where the emphasis was that there are very few such courses in Slovenia and they are mostly attended abroad. It was also pointed out that training not only in vertical hydroponics but also in horizontal hydroponics is being taken abroad by farmers and organisations, and that some are hiring foreign experts to host them at their companies/farms. Farmers are also helped by literature available on the internet. We believe that in addition to training, we should also have practical demonstrations of what it actually means to have hydroponic production, as many people have no idea. One of the initiatives was to introduce pilot testing projects and to do different research on the basis of that.

Our respondents come mainly from the Pomurje region, where hydroponic cultivation is most developed and where the location and climate are most favourable (due to the heating itself and the use of thermal water). In the Central and Gorenjska regions, however, equipment providers and various consultants predominate.

The surveys have shown us that the need for knowledge is considerable. Technical, agronomic and marketing skills. We find the definitions of skills in the survey acceptable. Those who were interviewed also agree. What we would like to borrow is, in addition to the above, a focus on: basic plant physiology, plant nutrition, growth requirements, nutrient solution needs and preparation, equipment knowledge, product advertising, etc. More than this, farmers and organisations pointed out that key customers are not familiar with this type of production, are not aware of what hydroponic cultivation actually means, and respondents indicate that hydroponic cultivation has a negative connotation and people avoid it. As part of the training, general awareness-raising should also be included, especially on the positive features of hydroponic cultivation. On the other hand, producers face higher costs (shorter storage capacity, higher investment, heating, etc.) and this is also why farmers do not opt for this type of

production. We would also like to highlight the funding for this type of cultivation, but in Slovenia, apart from the fact that it is in the plan, there is no specific definition of how much funding is earmarked for this type of cultivation, which is the downside of Slovenian policy, although it is stressed how important it can be, especially from the point of view of the climatic situation.

In conclusion, we propose the following training packages:

- Introduction of Hydroponic technology: greenhouse layout, what is important (location, materials, etc.), research on the prevailing climate. Equipment needed (led lights, measuring devices - sensors, etc.). Energy efficiency

- Plant growth requirements: basic plant physiology, plant nutrition, growth requirements, nutrient solution needs and how to prepare, suitable plants for cultivation.

Hydroponic growing system: description of hydroponics examples, development of a hydroponics plan,

- Management on a commercial hydroponic farm: the basics of farm/organization management (costs and income, canvas model), how to access the market, designing a promotional campaign, and how to create brand.