M.Sc Interaction Technology Thesis

Farmers and social media: a tool that assists farmers with creating posts for social media

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1. Introduction

Social media platforms have become so popular in the last few years, that people started incorporating them in their businesses as well rather than only using them for sharing vacation pictures or keeping in contact with their friends and relatives. The presence of social media has also had an impact on the farming industry. From information sharing to finding new customers, farmers acknowledged the importance of these platforms and the various activities that can be done with them. From previous studies such as Naruka et al. (2017) or Zipper (2018) we found that farmers consider social media as a 'convenient' communication application that can also be used for problem-solving or problem-identification in a quick way. They also use these technologies for sharing information with other farmers but also with their consumers or customers about issues that come along with food production (Connolly, 2017), GMOs (genetically modified organisms) and agricultural science (McConnell, 2015; Prakash, 2020) or even just about their farming experiences (Singh Nain, Singh and Mishra, 2019).

However, while there are numerous advantages to using such technologies, there are also numerous disadvantages and barriers that prevent farmers from engaging with them. The digital literacy rate (Sayruamyat and Nadee, 2020), education level (The National Institute for Literacy, n.d.), lack of infrastructure or time (Naruka et al., 2017), misinformation, and unfitting designs (Syahlani, Haryadi, Abdillah and Widyaswara, 2019) are some of the problems that farmers encounter when trying to work with such systems. From a bachelor thesis Van Zandbrink (2017), we find out that farmers notice a distance between them and the citizens because of the following reasons:

- A knowledge gap created by the fall in the number of farms and farmers, and
- Critics that create an incorrect image of agriculture industry

Furthermore, in the literature review conducted as a preparation for this thesis on farmers and social media, we could not find studies that explore the non-farmers' perspective on farm-related content on social media. Therefore, some measures should be taken to overcome this shortage of research and the challenges experienced by farmers with social media.

Based on the analysis and the findings presented in Chapter 2, this thesis takes a look at how non-farmers (i.e. people who do not work in the agriculture industry) consume and contribute to farm-related content on social media, while also taking into account how to improve the farmer's experience and the process of creating posts for these platforms. We try to understand on a deeper level how the relationship between farmers

and non-farmers occurs on social media platforms. By firstly understanding the non-farmers' perspective, followed by a more in-depth analysis of the farmers' interaction with social media, we propose a solution aimed to help farmers with creating posts on social media while also trying to improve non-farmers' consumption and contribution of farm-related content on social media.

Building upon the above-mentioned ideas, we have developed five research questions through which we first look at the farm-related content and then we analyze a tool designed to help generate the right content.

RQ 1: How does the type of information/feed that farmers share influence non-farmers' consumption and contribution of farm-related information?
RQ 2: How does the type of media presented in the feed influence non-farmers' consumption and contribution of farm-related information?

RQ 3: How might the process of creating and sharing social media posts by farmers be improved?
RQ 4: What impact does a tool created for farmers to create social media posts have on their creation process?
RQ 5: How does the tool influence non-farmers' consumption and contribution of farm-related content?

An overview of the thesis is presented below. Chapter 2 contains a short summary of the literature review conducted during the Research topics, while Chapter 3 presents the Research Questions analyzed in this thesis along with the procedures used. Chapter 4 describes how non-farmers consume and contribute to farm-related content on social media, while in Chapter 5 farmers' usage of social media is presented more in depth. In Chapter 6 the tool conceptualization is presented, followed by the usability testing with non-farmers in Chapter 7 and a working prototype testing session with farmers in Chapter 8. In Chapter 9 the content generated in the previous chapter by farmers is used in order to analyze non-farmers' consumption and contribution. Chapter 10 and 11 outline the main conclusions and identify the limitations of the study and recommendations for future research.

2. Related Work

During the literature review which is based on Iurescu (2020), we have analyzed the existing research on farmers and social media to see whether and how they use these platforms. In addition to existing articles, we also analyzed groups, pages and accounts from different social media platforms that belonged to the farming industry.

The findings from the literature review present us that farmers engage with social media on a daily basis, however only 5.9% from 733 farmers who participated in a study, use these platforms for their farm (Wyn & Penri, 2017). Some of their preferred platforms according to a study conducted by Balkrishna and Deshmukh (2017), are WhatsApp (50%), followed by Facebook (28%) and Youtube (18%). WhatsApp was also the main method of social media communication used by young farmers, as a study conducted on 300 farmers showed (Nurlaela, Hariadi and Raya, 2020). In Nigeria, however, Facebook was the most prominent social media platform among farmers, followed by WhatsApp (Iwuchukwu, Eke, and Nwobodo, 2019). Lastly, another study conducted by Farm Futures in 2016 on 1,500 farmers found that Facebook is the most prominent social media site among farmers, followed by YouTube, Twitter, and Instagram (Wilson, 2016; Glaves, 2017).

Based on existing research, it was possible to distinguish the information farmers share on social media into four main categories as follows:

- Farming and personal life: farmers sharing pictures of their family and friends and keeping in contact with relatives (Glaves, 2017), farm tours and visits, agrotourism (SocialB, 2015; Hardesty, 2011)
- Farming technology: from the Facebook groups “Farming Technologies” and the Facebook pages dedicated to the games “Farm Seaside Community” and “Farming Simulator”
- Agricultural products: promotion (Allen, et al, 2012; Glaves, 2017; Vassiliadou, et al, 2011), the nutritional information (Zhao and Zhang, 2017; Tobey and Manore, 2014), and the ways of production (Glaves, 2017)
- Farming news: agricultural news and issues (McConnel, 2015; Prakash, 2020), goals and farming practices (Glaves, 2017), and farm business advice and strategies based on the Facebook group called “Small Scale Farming as a Business”

Motivations for using social media in the farming industry as found from the literature review conducted:

- Problem-solving or problem identification: social media platforms can be used for identifying emerging agricultural issues (i.e. crop pests, bad weather conditions)

and guide the aid towards the affected region (Zipper, 2018; Amanatidou et al., 2012). This was also seen in a study where farmers from India considered WhatsApp as a ‘convenient communication’ tool that can also be used for problem solving (Naruka et al., 2017).

- Information collection/gathering: Farmers may use social media sites to search for and discover farm-related information because they often see each other as their primary source of information, and their interpersonal networks have an impact on their farm learning and decision-making (Skaalsveen, Ingram & Urquhart, 2020). To give a more concludent example, 44% of farmers who participated in a study stated that in order to acquire information on products and services for their farm, they watch videos on platforms such as YouTube (Karlberg, 2017).
- Dissemination of information: Practitioners from regional Farmer Innovation Groups across Europe indicated that social media, videos, and decision support tools were useful mechanisms for sharing information online (Bliss, et al., 2019). Farmers can share with consumers or other farmers their agricultural experiences, practical implications, economics, achievements, and failures through these forums. Furthermore, Mike Haley, Ray Prock, and Darin Grimm of the AgChat Foundation came up with the term "agvocate" to describe agricultural activists who use social media to proactively share information about agriculture and current events through the eyes of farmers and food producers (Connolly, 2017).
- Public relations, entrepreneurship and eCommerce: A number of studies have shown that social media allows farmers to connect with their customers and sell their agricultural products (Glaves, 2017). For example, many agricultural organizations have begun to use Twitter to promote their products and agriculture as a whole, as well as to communicate with audiences in novel ways (Allen, Abrams, Meyers, & Shultz, 2012).
- Adapting farming processes and products to public feedback and expressed needs or desires: Farmers often use social media to communicate with customers more effectively, and they value the feedback they receive and consider their input to be especially useful. A social media application called WeChat was used in a study conducted in China to investigate its effect on producer-member relations in community-supported agriculture (Chen and Tan, 2019). Farmers will use social media members' suggestions and views to make changes to their business services and products, as well as strengthen social ties with customers, according to the findings. The social media application was thought to be helpful because it connected the two groups, producers and consumers, in a more effective manner.

In addition, from the thesis conducted by a student from Wageningen University and research on farmers and social media (Van Zandbrink, 2017), we find that other core motivations for why farmers connect with citizens via social media are to promote the agricultural sector, inform the citizens, developing goodwill, future expansion perspectives of the farm, and lastly to provide input for the new regulations changed by local authorities when these affect them as well.

Even though farmers have different motivations for adding social media to their daily farm activities, there are also some barriers that farmers can encounter. A first limitation could be the education level and digital literacy rate of farmers. For example, in Pakistan, where agriculture is the country's mainstay (Agriculture Department Government of The Punjab, n.d.), the literacy rate is 59.13 percent (World Bank, 2019), and studies have shown that text-to-speech features are required when designing human-computer interfaces for them to assist with their agricultural activities. This idea is backed up by a study of 727 Thai farm households, in which the farmers' digital literacy was assessed through a survey (Sayruamyat and Nadee, 2020). Despite the fact that the majority of participants had smartphones, less than 30% of them used social media, and despite their enthusiasm for digital technology, the adoption rate was surprisingly low. Moreover, the lack of infrastructure and time issues are also worth mentioning as farmers lead a very busy life and they do not afford to waste their valuable time on unnecessary activities. To support this idea we saw that even though farmers thought WhatsApp was an easy-to-use application, distraction and exposure to unregulated messages or information were considered problems in a study conducted by Naruka et al. (2017). Lastly, another major problem that can be seen on social media when it comes to the farming industry is the presence of misinformation. Because there are many untrustworthy sources (i.e. other farmers, organizations) that post misleading information, farmers who take that data seriously and try to apply it to their business can be negatively affected, resulting in time and financial losses (Yonder, 2018).

Overall, we can say that the presence of social media in the farming industry has a lot of positive aspects, however there are also negative factors that need to be taken into account as they influence the farmers’ engagement with this technology and prevent them from using it.

3. Goals and Approach

In the preceding sections we used a literature study to look into how farmers include social media into their farming practices, as well as the benefits and drawbacks that this technology entails. Furthermore, we found that there is a lack of research on how non-farmers perceive farm-related content presented on social media and whether they are interested in receiving such information. Taking all into consideration, in this chapter we will present how we addressed the research questions presented in Chapter 1 throughout the research project.

RQ 1: How does the type of information/feed influence non-farmers' consumption and contribution of farm-related information?
RQ 2: How does the type of media presented in the feed influence non-farmers' consumption and contribution of farm-related information?

For the first two research questions an online survey was implemented and distributed to non-farmers. In order to determine whether the type of information presented in posts shared on social media has an influence over the non-farmers' perception, four fake Twitter feeds were created and added to the survey. These fake feeds were developed based on the four categories of information found in the literature review. Afterwards, participants' consumption and contribution of the presented feeds was analyzed based on four items as follows: likeness level, interest level, desire to see similar feeds and desire to subscribe to similar feeds.

When it comes to the type of media presented in the feeds, the same feeds used for the first research questions were used. However, there were two conditions in which the feeds will be presented. The first condition will contain text-only feeds where the information will be presented only in text format, while the second condition will also include images besides the text. This way, half of the participants saw the feeds in the first condition while the rest of them saw the second condition.

RQ 3: How might the process of creating and sharing social media posts by farmers be improved?

In order to answer this research question, interviews with farmers were conducted in order to get more in depth information regarding their usage of social media. Moreover, their interest in a tool designed to aim them in creating posts for social media was analyzed. Afterwards, based on the findings from the interviews, a prototype for a mobile application was implemented. In a first stage, wireframes were created and a

usability testing session with farmers occurred. Following that, a mobile application was created.

RQ 4: What impact does a tool created for farmers to create social media posts have on their creation process?

As mentioned before, the tool designed to help farmers with posting on social media was created as a mobile application. This mobile application was then given to farmers to test during a period of time. Participants were asked to create posts without the tool but also with the help of the tool. An interview was conducted to discuss their interaction with the application.

RQ 5: How does the tool influence non-farmers' consumption and contribution of farm-related content?

Lastly, using the posts created by farmers through the tool designed for them, another survey was created. In this survey, the posts were compared to previous posts that were not created using the tool. Similarly to the first survey, non-farmers' consumption and contribution with the information presented in those posts were examined.

4. Non-farmers' Perspective on Social Media Content

In the previous chapters, we have seen how farmers include social media with their personal life and business but also how they interact with these platforms. Furthermore, we see the problems farmers encounter when using such platforms but also the benefits that come when these situations are conquered. However, we noticed that the perspective from the other side, the non-farmers' part, has not been analyzed throughout literature. For this reason, the following chapter will present the analysis of the non-farmers' relationship with farm-related content presented on social media. Firstly, the method will be presented, followed by a description of the results and findings.

4.1 Method

Participants

Throughout this section, we refer to the participants of this study as being non-farmers, the main criterion based on which participants were selected was that they were not actively involved in the farming industry. Besides this, it was also mandatory that the participants were over the age of 18.

For this, people were selected through usual recruitment methods. Firstly, the questionnaire was shared on the Facebook group dedicated to students from University of Twente. Secondly, a survey exchange platform, called SurveyTandem, was used to find participants. And lastly, the questionnaire was also shared with acquaintances which in turn shared and recommended it to other participants. Lavrakas (2008) describes that in the convenience sampling method the participants are sampled because they are considered "convenient" sources of information for researchers. Snowball sampling, according to Goodman (1961), is a process in which a random sample of people is chosen and each of them recommends a number of additional people. These respondents were selected using a combination of two non-probability sampling methods, more precisely the convenience sampling and the snowball sampling.

The sample size necessary for the survey was considered to be 50, 25 participants for the first condition and 25 for the second condition. In the end, there were 54 respondents from which only 52 responses were taken into consideration for section D and E of the survey because of some missing values. Furthermore, participants were randomly assigned to two groups, based on the two conditions included in the study. Thus, 25 of them saw the text-only version of the feeds while the other 27 saw the image and text version.

Study design

Social media platforms are nowadays used in all domains as they have become an excellent way to connect and communicate directly with customers (Rahman et al., 2016). Through these platforms, individuals and organizations can interact easily with their consumers by sharing information related to their activity. In turn, the consumers can respond to the content that is being shared. This response is usually called user engagement, and it represents how engaged an audience is with the content that is being presented (Barnhart, 2020). This user engagement can be measured quantitatively through social media metrics, such as likes, followers and shares (Baym, 2013; Kietzmann et al., 2011).

In 2016, Schivinski, Christodoulides and Dabrowski extended and validated a framework/scale, called COBRA, which was to be used to measure consumers' engagement with brand-related content on social media. The initial scale was developed by Shao (2009) and Muntinga et al. (2011).
According to this scale, the user engagement with brand-related content on social media can be classified over 3 levels: consumption, contribution and creation.

- Consumption refers to the situation in which a user sees a post on social media
- Contribution comes in place when after seeing the post on social media, the user decides to like or comment on that post (thus moving from the stage of observer to a media contributor)
- Creation is the last phase, when the user takes "action" on his side and decides to post brand-related content on his social media accounts (i.e. a photo with a product that belongs to a brand)

Given that this thesis does not necessarily address brands, but is being more focused on individuals (farmers) and (agricultural) organizations, it was considered appropriate to use the first two levels of the COBRA scale to analyze the non-farmers' engagement with farm-related content posted on social media, with an emphasis on the contribution.

Procedure

A web-based survey was selected for the study utilizing multiple-choice, matrix and open questions. Qualtrics, a platform used for creating and distributing online surveys, was selected for the implementation of the questionnaire. The survey was available online for a period of one month, from the 12th of August until the 3rd of September 2020. An informed consent was attached at the beginning explaining the purpose of the study, the researcher's information, the anonymity of participants, and the confidentiality of the information. The study was performed in accordance with the ethical standards

and approved by the Ethics Committee of the EEMCS faculty of the University of Twente under the reference number RP 2020-107 (date of approval: 10 July, 2020).

The survey started with a standard demographic section which included three questions about social media use as follows: *"Which of the following social media networks do you use?" with the response options being "Facebook / Twitter / Instagram / LinkedIn / YouTube / Snapchat / WhatsApp / All of the above / Other (please specify)"*, *"How much time do you usually spend using social media networks on a daily basis?"*, and *"Do you use social media networks for professional purposes?"*. The questions were taken from a study conducted by Alsobayel (2016), but it should be noted that they were updated to reflect newer and more contemporary social media platforms. We also asked one question about general interest in farming content, (*"How interested are you in seeing farm-related content on social media platforms?"*). This was followed by a matrix question about motivation (*"What would be your motivation for seeing farm-related content on social media?"*) with a list of options inserted below the question. Some of the proposed motivations were taken from the research conducted by Munar and Jacobsen (2014) and modified accordingly to fit the farming topics, such as the *"I want to get help from farmers" and "I want to avoid buying bad agricultural products"*. The other options were written based on some of the papers and findings from the literature review as follows: *"I want to be more engaged with the farmers."* because judging from the other side, farmers also want to engage more with customers through social media (Bhatia et al., 2013), *"I want to receive trustworthy information directly from authorized farmers or agricultural scientist"* because of the misinformation problem (Williams, 2019), *"I want to buy products directly from the farmers"* because of the presence of eCommerce Facebook groups, *"I want to visit farms"* because of the presence of agritourism (SocialB, 2015; Hardesty, 2011), and *"I want to (start) work in the farming industry"* because of the presence of the Facebook group "Small Scale Farming as a Business". A 5-points agreement Likert scale (1 - Strongly disagree, 5 - Strongly agree) was used to measure motivation.

The differences in the non-farmers' preference of the type of post were also analyzed because studies showed that the format of the social media posts influences the interest and engagement of the viewer (Kim & Dennis, 2018; Kim, Spiller & Hettche, 2015; Valerio, Herrera-Murillo, Villanueva-Puente, Herrera-Murillo, Del Carmen Rodriguez-Martinez, 2015). This was considered to be helpful for the farmers to know on which type (i.e. text, photo) to focus when posting on social media platforms. For this, four fake Twitter feeds were designed, each containing three posts. The feeds were created based on the four categories of farm-related information mentioned in the literature review. Given the nature of the study was an online survey, in which pictures with fake Twitter feeds were presented, it was difficult to include a video-condition to be

analyzed as well. Moreover, as farmers are known to have time issues, it was considered that text and photos to be the most efficient media types for them to share on social media platforms, as video requires more effort and skills than the other two.
The first feed focused on agricultural products, the second on farming life, the third on technology and the last one on general news about farming (see Figure 1). The participants were shown the four feeds in a randomized order. After each feed a matrix question was shown, containing the following four statements *“I like this feed”*, *“I am interested in this feed”*, *“I want to see more like this feed”*, and *“I want to subscribe to this feed”*. The same Likert scale from the motivation question was used for this as well.

Regarding the COBRA scale, all the measurements of user engagement were used to create a scale for the “non-farmers’ engagement with farm-related posts on social media" as follows:

- “I like this feed” can be connected with the number of likes
- “I am interested in this feed” is used to represent the number of shares/re-tweets
- “I want to see more like this feed” is used to represent the number of followers (i.e. see/be notified, when the person posts)
- “I want to subscribe to this feed” used for the number of subscriptions (i.e. pay monthly a fee for the person that is being followed to see the content)

Furthermore, the feeds were presented in two ways based on the media type (see Figure 2) as follows: one text-only, and the other one, text plus image. In order to properly compare the differences between the types of media, half of the survey participants were shown the text-only feed, and half were shown the text plus image feed. To minimise the bias, the feeds were presented in random order. The individual fake tweets were created using an online free generator called “tweetgen”, which were later joined together to mimic a Twitter feed using Adobe XD. Images were taken from free platforms, such as Unsplash and Pixabay. In the end, the interest regarding different types of farm-related information taken from the literature review was analyzed. Using the findings from the existing literature, a matrix question with 13 options was implemented and a 5-point Likert scale was used to measure the interest. An open-ended question was also included that would allow participants to specify additional information that they would want to receive from farmers (“Describe other topics/information that you would like to receive from farmers through social media.”).

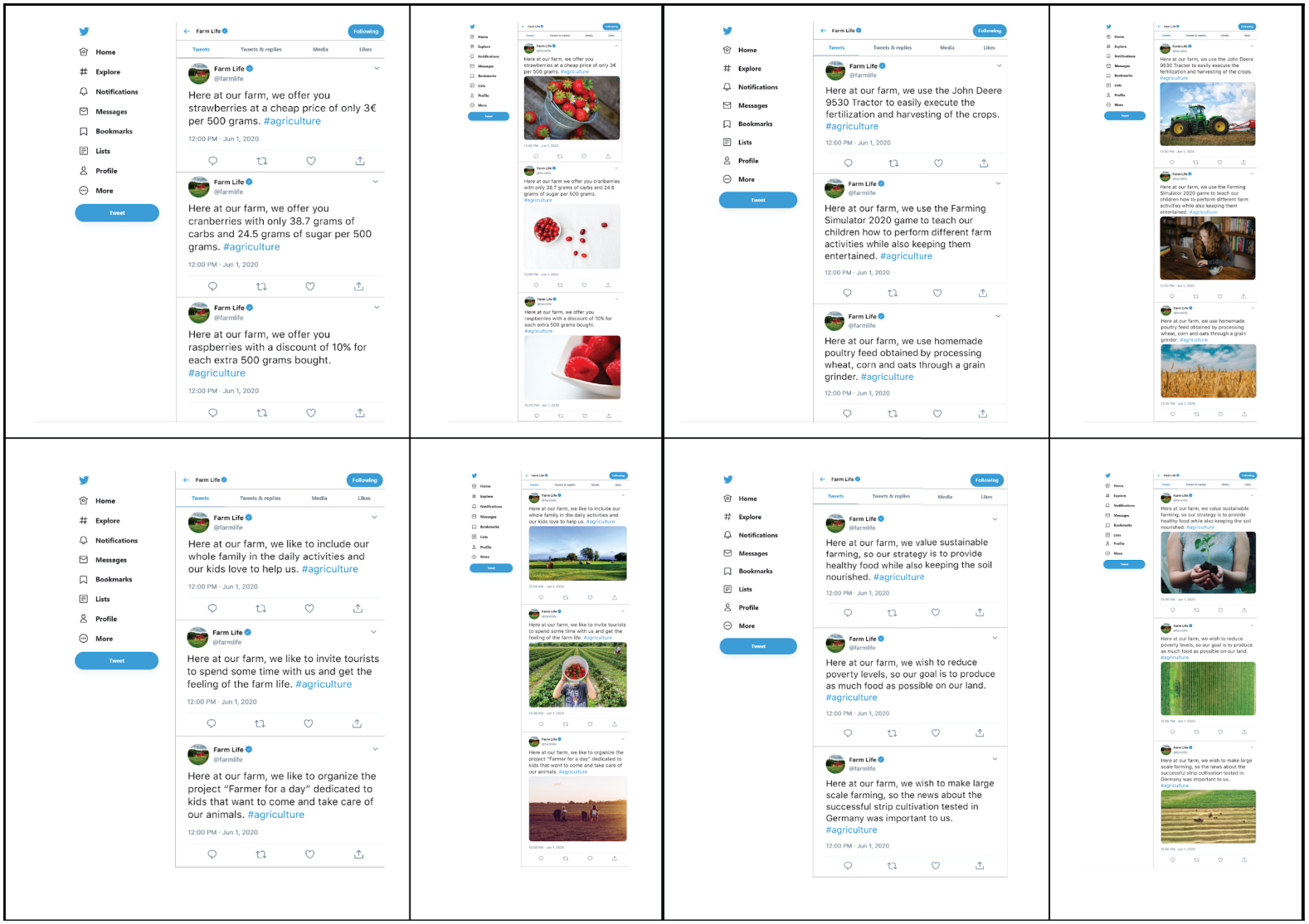

Figure 1. All fake Twitter feeds used in the survey describing agricultural products *(above left)*, technology *(above right)*, farming life *(below left)*, and news *(below right)*.

Figure 2. Close up of a fake Twitter feed with three text-only posts *(left)* and three text plus photos posts *(right)* about the price, the nutritional values and the promotion of agricultural products.

4.2 Results

Social media demographics

The survey created using Qualtrics was published for a period of 3 weeks in order to gather the necessary responses. It was distributed using an anonymous link and a total of 55 participants were recruited. The only requirement was that the participants were over 18 years old and that they were non-farmers. 54 of the participants agreed to complete the survey and one participant disagreed thus, 54 responses were taken into consideration for further analysis. The response from the participant who disagreed was removed. About 74% were aged between 18 and 29 and about 26% were between 30 and 49 years old. Furthermore, 28 of the respondents were females and 26 were males. With regard to nationality, 27 of the participants were Romanian, 4 British, 3 Indians, 2 Germans, 2 Dutch, 2 Americans, 2 Thai, 1 Nigerian, 1 Turkish, 1 Italian, 1 Isrlaelian, 1 Indonesian, 1 Greek and 1 mentioned being Asian.

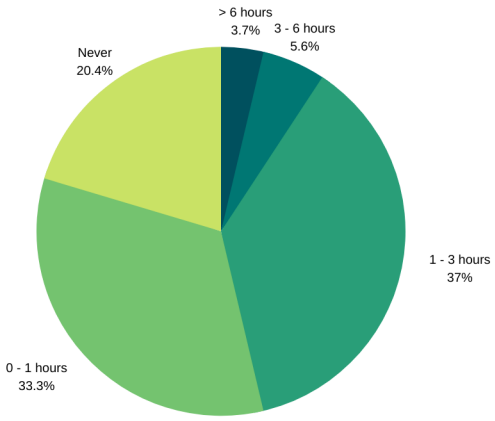

Figure 3. Work hours spent on social media per day

When it comes to social media usage, YouTube and Facebook were chosen by 48 and 45 of the participants as being the most used social media platforms, followed by Instagram and WhatsApp with 37 and 36 votes, respectively. LinkedIn and Twitter had a similar number of votes, 17 and 16, while Snapchat and ResearchGate or Academia had 6 votes each. The least chosen was the blogging service (i.e. WordPress, Tumblr) with 5 votes. Other social media platforms mentioned by the respondents were Reddit, Discord, Goodreads, TikTok, Oculus and “music streaming services”. About 37% of the respondents used the above-mentioned social media platforms for 1 to 3 work hours per day and 57.41% used them for 1 to 3 non-work hours. 33% said they used social media for 0 to 1 work hours, 20% said they never use it during work hours, 5% said for 3 to 6 work hours while only 3% of them declared they use it for more than 6 hours. Moreover, almost 26% declared that they use social media for 3 to 6 non-work hours, 9% for 0 to 1 hours, and 7% for more than 6 hours.

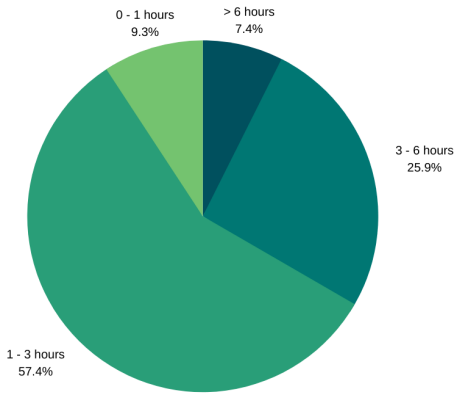

Figure 4. Non-work hours spent on social media per day

When it comes to the general interest in seeing farming related content on social media, 20% of participants said they are very interested, 35% moderately interested, 37% slightly interested and only 8% said they were not at all interested. Thus, non-farmers are generally interested in viewing farm information on their social media newsfeed.

Motivation for seeings farm-related content

Regarding the non-farmers' motivations for seeing farm-related information on social media, data gathered from the study suggests that the main motivations were *receiving trustworthy information directly from authorized farmers or agricultural scientists* and *avoiding buying bad agricultural products*. *Buying products directly from farmers, wanting to visit farms and being engaged more with farmers* were also considered important elements of motivation. On the other side of the spectrum, participants were not motivated by the idea of *working in the farming industry*. Lastly, respondents were mostly neutral about *Wanting to get help from farmers.*

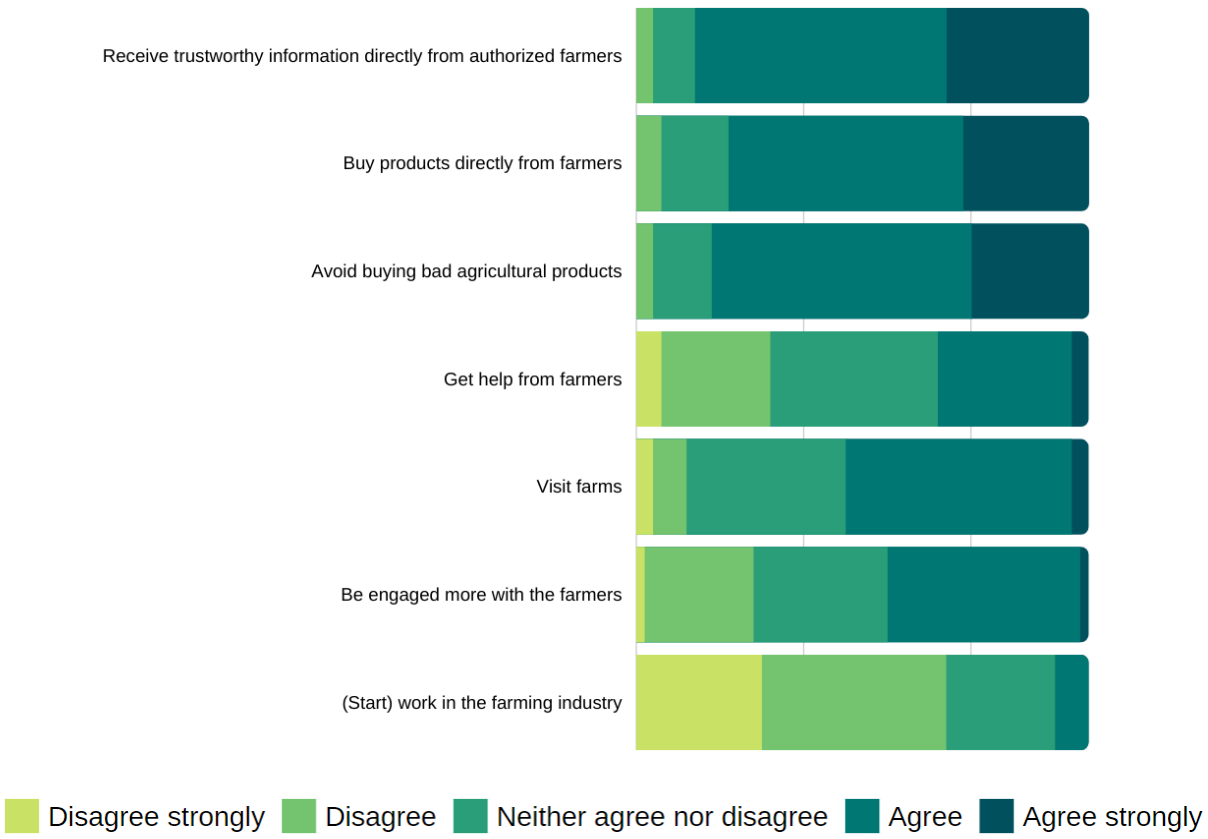

Figure 5. Motivation for seeing farm-related content on social media ("*I want to ...")*

Interest in farm-related topics

Next, the interest level for the 13 categories of farm-related information is presented (see figure below). Two of the categories aroused participants' interest the most, namely *agricultural product production methods* and *agricultural product nutritional information*. Non-farmers found information about *agricultural product promotion, availability, and prices* to be very interesting, while details about *agricultural goals, volunteer programs, agricultural news, global agricultural issues, and GMOs (genetically modified organisms)* were moderately to very interesting. Similarly, data about *farming practices* and *farm tours or visits* were also considered moderately to very interesting. While information about *farming technologies* was identified as slightly to moderately interesting to very interesting, data about *farming mobile and web games* was considered as one of the least appealing categories of farm-related data. The *personal lives of farmers* were also deemed uninteresting or just slightly interesting by the majority of the participants.

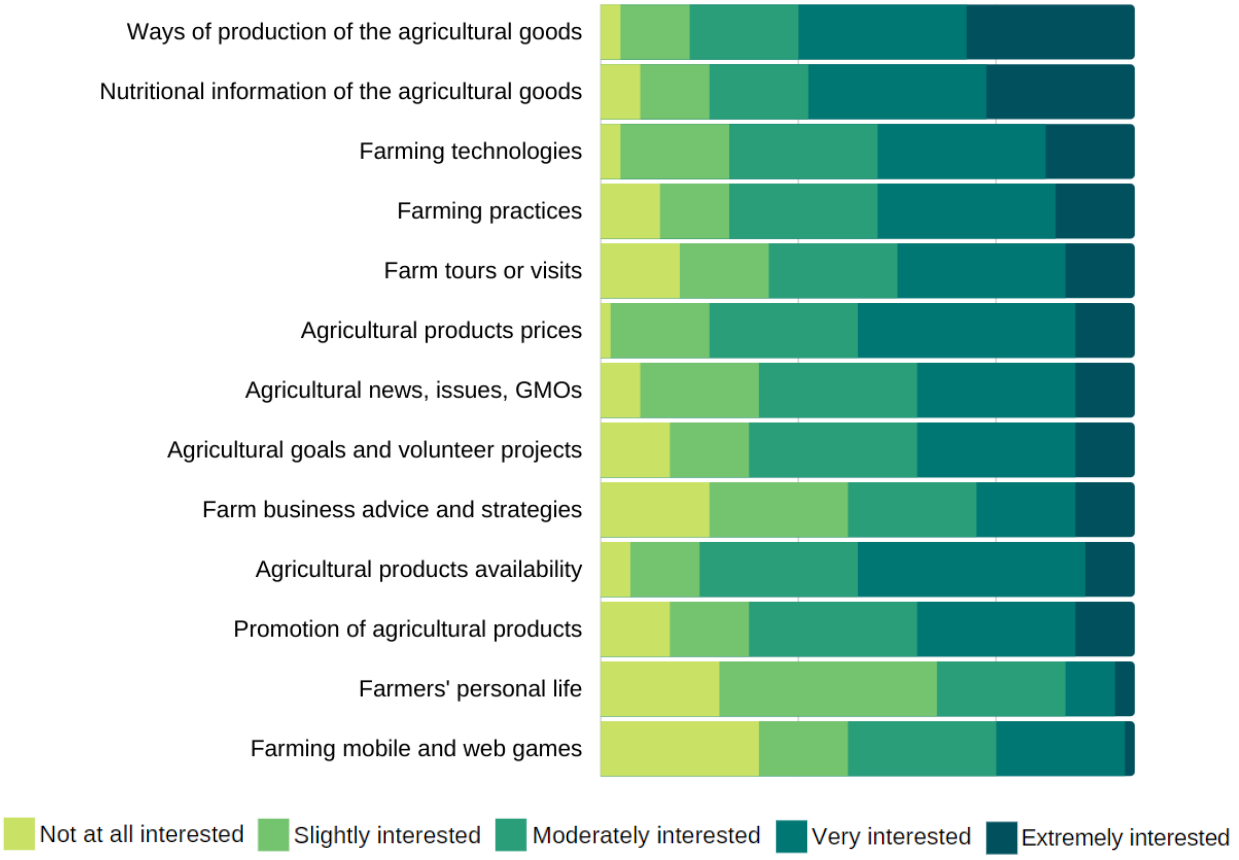

Figure 6. Categories of farm-related information and non-farmers' interest

For the last question of the survey, where participants were asked to describe other topics or information that they would like to receive from farmers, only 18 responses

were received. People were interested in receiving information regarding the products, such as *"prices, quality checks or how to look for the best products"*, *"local food availability"* and *"localisation and time to maybe buy their product"*, but also suggestions on *"how to cook their products"*. Furthermore, they were also curious about different farming practices, such as *"how products are prevented from GMO"*, *"how to cultivate vegetables/fruit at home"*, *"plant growing tutorials"*, *"what they do in times of heavy rain"* but also about *"future of farming technology"* and *"software usage"*. The beginning of their farming (*"How they started their business/farm"*) but also how farming takes place in urban areas were also some of the mentioned aspects. One of the participants even mentioned that it would be interesting to see the *"impact of coronavirus on farming"*.
We could also notice two preferences regarding the type of media that could be posted on social media by farmers, with *"photos of their farm animals (how healthy they look and how they are kept)"* and *"farmers vlogs"* being mentioned by respondents. For the latter, one of the participants also wrote that he would like to see how a *"day in the life"* of a farmer would be, while another one said that *"the Twitter post about the farm activity for kids to learn farm activities while having fun was nice. Things like that, that are entertaining, and not just promotional"*.

Category of farm-related information and type of media

In order to be able to interpret the matrix question that followed each feed and to furtherly correlate the answers with the COBRA scale, Cronbach's alpha was calculated in SPSS. This analysis was conducted in order to check the reliability of the proposed scale and the internal consistency. It resulted in a value of .906, thus being reliable as it was higher than the required value of .70. Next, the Principal Component Analysis (PCA) was performed and according to the Total Variance Explained, it resulted that there should be one factor extracted. This was helpful because it demonstrated that the items of the matrix questions belong to the underlying construct of the COBRA scale. Following, given the statistical support, the responses/values of the four items (*"I like this feed", "I am interested in this feed", "I want to see more like this feed", "I want to subscribe to this feed"*) were analyzed under the form of a continuous scale (*1 to 5*) instead of the actual Likert scale (*"Strongly disagree", "Disagree", "Neither agree nor disagree", "Agree", "Strongly agree"*) format question that was used. The numbers were then averaged by using SPSS and the results were analyzed using Mixed ANOVA. It is worth mentioning that this is an exploratory analysis and that given the original form of the data being ordinal scale and having a non-normal distribution, we assume that once the data is averaged, the distribution becomes close to normal.

As we can see from the data presented in the graph in Figure 7, there were some differences in the answers for the categories of information and the type of media

presented in the feeds. However, as described below, these differences were not statistically significant.

First we looked at the Box's Test of Equality of Covariance Matrices table in which the p-value was 0.237, thus higher than 0.05. Then the p-value from Mauchly's Test of Sphericity table was 0.146, so we looked into the Multivariate Test table. Here the p-value reported was 0.254, which means that there was no evidence of a significant main effect.

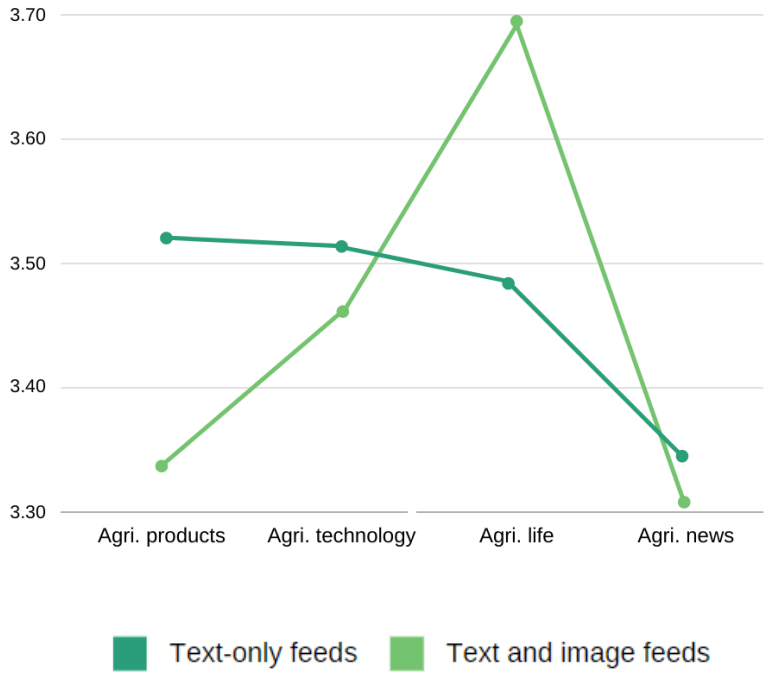

Figure 7. Mixed ANOVA results

For the first research question but also for the second research question there were slight differences in non-farmers' consumption and contribution of farm-related content on social media, however there is no statistical significance to reject the null hypotheses. As a result, we can conclude that neither the type of information nor the type of media had an impact on the consumption and contribution of farm-related content by participants in our study. Therefore, it can be said that judging by our results, farmers do not need to focus on a specific category of information or type of media when sharing content related to their farm, but they could create their posts around these categories.

5. Getting More Insights Into How Farmers Use Social Media

In this chapter we will look at how farmers use social media for their business and the issues they face along the way. First, we will go over the method used for this part of the research, and then we will present the outcomes and discoveries.

5.1 Method

Interview

In order to get more in-depth information and qualitative data about how farmers use social media, interviews were conducted. There were a few reasons why we selected to use interviews with farmers such as the ability to gain insight and context, allowing participants to describe what is important to them and enabling more complex questions to be asked (Doody and Noonan, 2013). We chose qualitative data over quantitative data because we wanted to hear directly from farmers about how they use social media and the issues they face. Moreover, we focused on semi-structured interviews because even though they have some predominant order, they allow for flexibility in the way issues are addressed (Longhurst, 2010; Dunn, 2003). We wanted to provide farmers the opportunity to participate in a more relaxed setting where they could express themselves freely.

In total we used eleven questions (see Appendix A) in this interview with farmers, from which four had follow-up questions. We included mostly open-ended questions, only the first and last questions were yes/no questions. We started with three questions about the general use of social media such as platform preference, intervals and whether they have a separate account for their business or they use a personal profile. We asked these questions because we were interested in finding out if farmers indeed use social media for their farm, on which platforms they like to spend time and how often they are able to use them.
Next, we wanted to find out how they perceive their interaction with social media and how they connect with consumers/customers but also with farmers on these platforms. We analyzed the above-mentioned to evaluate if there were any noticeable differences between how they communicate with consumers and how they connect with other farmers. Then we wanted to find out what type of information they usually share on social media and if they have a preference in the type of media. We did this to determine whether there were any parallels between their responses and what we observed in the literature study and the previous survey.
Through questions 9 and 10 we wanted to hear directly from farmers about the problems they encounter when using and posting on social media, but also their

suggestions on how these problems can be overcome. Lastly we asked farmers if they were interested in using a tool that helps them with posting on social media. This was done for two reasons: one, to see if they were available to test such a tool, and second, as a way to attract people for our testing session.

Participants

For practical reasons we scoped this part of the research to only two countries, Romania and Netherlands. This was decided because it would fit with the majority of the respondents from the first survey and also with getting respondents for this and following parts of the project. For the farmers in Romania, a post was made and shared on three farm-related Facebook groups called “Fermieri & Agricultura in Romania” (Farmers and Agriculture in Romania), “Agricultura. Ferma. Fermieri. Romania” (Agriculture. Farm. Farmers. Romania) and “Tineri Fermieri din Romania” (Young Farmers from Romania).

With the help received from a contact from LTO Noord, an organization dedicated to people from the agricultural industry with around 35000 members, farmers were announced about the thesis project on their Facebook group. Several of them agreed at the beginning to participate in the study, however because of the language barriers only one of them took the interview in the end. In total there were 6 participants who agreed to take part in the interview, 5 farmers from Romania and 1 from The Netherlands. In terms of gender, 5 of the farmers were males and 1 was female, all of them between the ages of 40 and 55.

Given the current situation with the pandemic and the fact that the farmers were from different places, the interviews were held over the phone and through video call. The interviews were programmed sporadically over the course of 3 weeks because of the busy schedule of the farmers.

5.2 Findings

Here follows a more thorough description of the results from the interviews conducted with the farmers.

Social media usage

To begin with, it is worth mentioning that from the six farmers interviewed, one of them did not use social media at all for farm-related purposes, one of them had a special page created for their farm-business while the other five used their personal page to

share farm-related information. We have adjusted the questions for the farmer who did not use social media for his business to be more focused on his personal usage. The common social media platform used by all the participants was Facebook. Farmers from Romania also mentioned WhatsApp and OLX, a Romanian platform used to sell various products online, while the farmer from the Netherlands said he uses Twitter more often than Facebook as it is “easier to use”. Regarding the occurrence of social media usage, three of the farmers said they use or post on social media daily, one of them said he does it weekly, and the last one said he only does it when it is needed as he does not have too much time. The time issue was also mentioned by the farmer from the Netherlands but also by the farmer that did not use social media for his business.

Customer relations

About their interaction with social media, one of the farmers mentioned that he does not trust this type of technology while another one said that they use it for sales purposes. The sales or business part was described more when farmers were asked about how they use social media to connect with consumers or customers. The farmer from the Netherlands said that all his products are going to the factory so he does not really keep in touch with his customers through social media, however when a consumer has a question or when he sees some news, he gives his reaction. He also stated that farmers should be careful when presenting farming practices to consumers as he encountered some situations with animal rights activists because of misunderstanding. Another farmer mentioned that they take their products directly to the market or they have an established pool of customers and thus they also do not get in touch with them through social media. Lastly, the other farmers mentioned that they get in contact directly on social media with customers that they see they are interested in their products.

Relations to other farmers

When it comes to the communication with other farmers on social media, all farmers mentioned that they are part of different groups on Facebook dedicated to farmers (except for the farmer who does not use social media). Information sharing (about pesticides, tools, prices) and problem solving were the most common reasons for talking with other farmers on social media. One of them even mentioned that if they see a new or interesting idea shared by another farmer, they will try to replicate or apply it to their farm. The farmer from the Netherlands said that he reacts to other farmers’ posts and invites them to follow his accounts. While this aspect of getting in touch with other farmers on social media and sharing information has positive aspects, it can also have bad sides as mentioned before in the thesis. As one of the farmers from Romania said “there are a lot of bad opinions and it can be very dangerous”. This misinformation

problem has been described by all the other farmers as well when asked about what is missing from social media. Even the farmer who stated that he does not use social media for farm-related activities agreed that misinformation is an important factor for why he is not on social media, along with time-related issues. Two of the farmers said that they sometimes get in contact directly with engineers or authorized persons when they have a farm-related problem. Other aspects mentioned were that there are too many platforms available and it is hard to choose which one “tells the right story” or that there are people who are scamming others with “weird” prices. It was also suggested that small farmers need to be encouraged or promoted more on social media and that there should be someone to give them advice on promotion.

Categories of shared information

Other categories of information mentioned during the interviews that farmers share online were information about European funds or about festivals related to agriculture. Two of the farmers declared that there is also too much information on social media and that it needs to be categorized in more detail so that it can be easier to find what they are looking for. Or as another farmer stated, “an administrator” who could take all the information and organize them based on category.

Types of media

In relation to the type of media used and preferred for the posts, the farmer from the Netherlands said that it is easier to post pictures with text on Twitter but for videos it takes more time. He also stated that from his point of view, it does not matter if there are pictures or not. One of the other farmers said that they post pictures with their animals and that usually people like their pictures, while another one mentioned that standardized products do not need promotion on social media through pictures or videos, however when it comes to unstandardized products it is preferable and more useful to add pictures/videos. He also said that he likes the fact that on social media his posts get engagement even after a few months after being posted. The last farmer said that he sometimes shares text-only posts, sometimes he also adds a photo and when asked by people, he also uploads a video.

When it comes to questions about the tool that would help farmers to post on social media, one of the farmers said that a platform that would be more accessible and user-friendly for farmers is needed and that such a tool should take into account the location of the farmers when showing the content. Another one stated that it could be useful even now given the current situation with the pandemic and that the process of promotion on social media should be made easier as now a lot of the farmers give up

because they feel harassed on social media by others. On the other hand, the dutch farmer considered that a tool for farmers to post on social media is not needed, as he for example could link Twitter and Facebook with just one button. In the end, all of the farmers interviewed stated that they will be interested to test the prototype after its implementation.

6. Tool Conceptualization Stage

In this section we describe the steps we took in the conceptualization of the prototype. We first talk about the customer journey map, personas and scenarios Then we present the wireframes and how these were developed. Lastly, we talk about how the templates included in the tool were created.

6.1 Customer Journey Map, Personas and Scenarios

Customer journey map

In this section of the thesis, the customer journey map is described. The customer journey map was implemented in order to better understand the interactions with the product from the farmers' point of view. According to Rosenbaum et al. (2017), a customer journey map is a chronological visual representation of the events that customers may encounter when interacting with a service organization during the purchasing process. Possible organizational touchpoints are also presented in the customer journey map, separated into three periods: pre-service, service, and post-service. In our case, the map presents the possible activities and touchpoints that the farmers go through before, during and after using the proposed tool.
In a study conducted on multiple companies, Temkin et al. (2010) discovered that the three key elements included in their customer journey maps were the:

- customer processes, or how they interact with the company
- customer needs, or what they want from each interaction
- customer perceptions, or how they feel about each interaction.

The customer journey map shown in Figure 8 was developed for this study based on Temkin's (2010) suggestions. Firstly, we describe the stages of the journey through which the farmers go when interacting with the tool across the life cycle of the relationship. The key activities and touchpoints within each stage, but also the farmers' needs from each interaction are also presented. In the end, the customer perceptions or feelings in relation to each of the steps were presented.

The three stages of journey, as described before, are pre-service, service, and post-service. In the first stage, we presume that the farmer is aware of the difficulties he faces while posting on social media and is seeking for a solution to overcome them. He then proceeds to look for a solution online and comes across the application. During this stage, the user experiences a range of emotions, from frustration due to difficulties to excitement due to the discovery of the application.

In the service stage, the farmer has their first interaction with the application. He sets up an account and starts creating a post to share it on their social media accounts. In this stage, the need is related to the interaction with the application and the process of creating posts. Because of the problems mentioned in the first stage, the farmer now wants an application that is easy to use and which allows him to share posts more quickly. Ideally, in this stage the user has only positive emotions based on their successful interaction with the tool.

In the third stage, the post-service, the farmer pays attention to the outcome of using the application. He notices the feedback given to his post by consumers/customers or other farmers and the way they consume and contribute to his content. He enjoys the fact that the feedback is positive and decides to continue using the application. Overall, the farmer is satisfied with how the tool solves his needs.

Personas and scenarios

To better understand the context in which our tool can be used, we have created two personas: Marcel, a 47 year old dairy and animal farmer and John, a 30 year old vegetable farmer. We have also assigned one scenario to each of the personas.

Marcel does not have too much time to spend on social media because of his farming life and duties. He finished high-school and got his diploma, however he has a low level of digital literacy. He lives with his family in a modest house and he owns a couple of animals from which he sells dairy and meat products. As for personality traits, he is social, likes to keep things on schedule and sometimes he can be very traditional.
Regarding user goals, Marcel uses this information system to begin his “adventure” on social media platforms for business purposes, to find useful information in case of a problem and to get in touch with customers.

Scenario 1 - A farmer, Marcel, encounters a problem and is looking for a solution on social media platforms: It’s Tuesday afternoon and Marcel sees that one of his animals has some weird spots on one of the legs. He decides to use the “tool” to ask other farmers on social media whether they know what this problem might mean. He opens his phone and takes a picture of the spots found on the animal’s legs. He then uses the tool to create a post that would be shared in multiple “farmer” groups on Facebook. He waits to receive answers from the farmers in order to solve his problem.

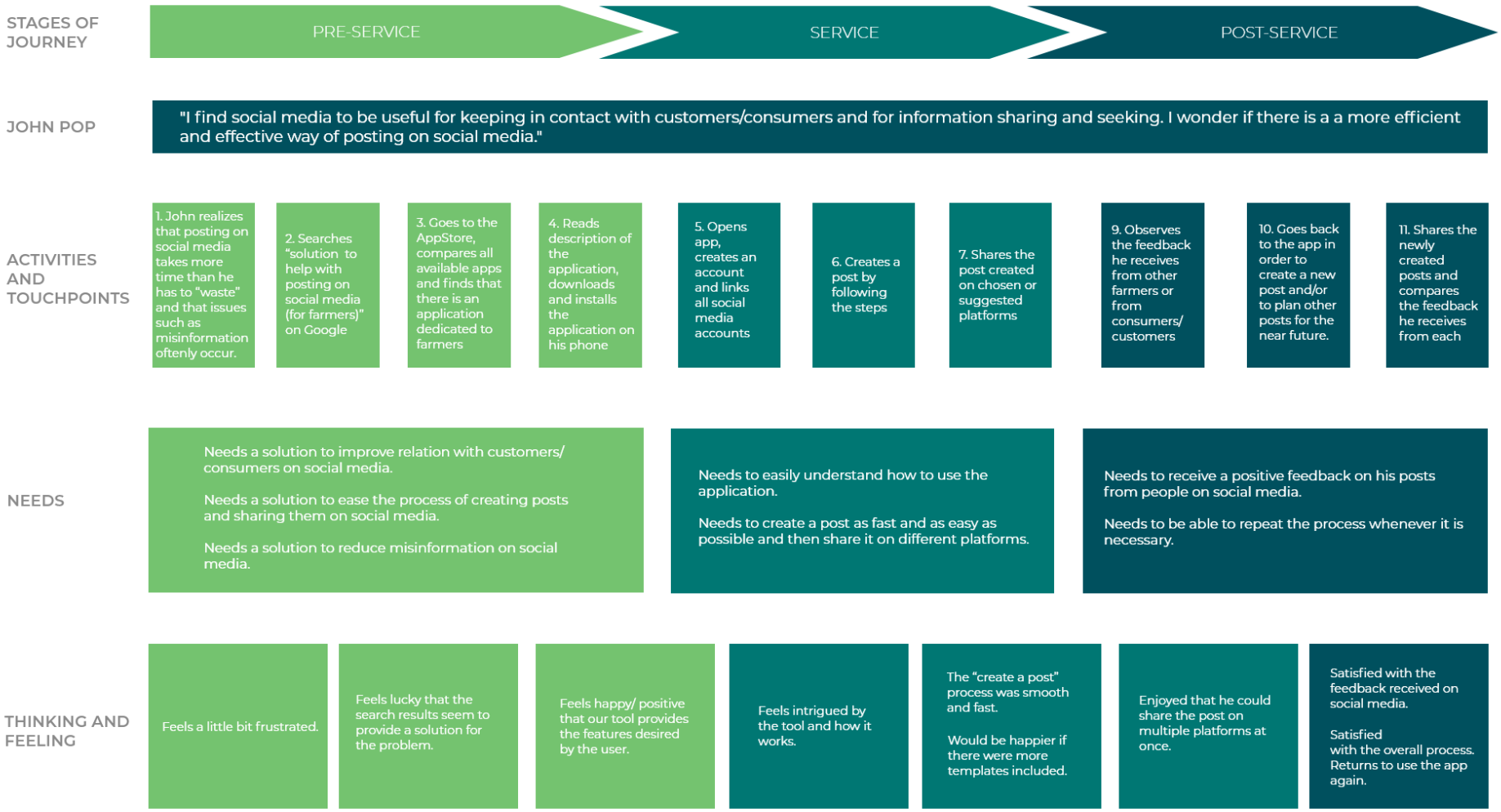

Figure 8. Customer Journey Map

John is a vegetable farmer that manages to find time to post weekly on social media platforms. He graduated from an Agronomics university and received his bachelor degree. He lives with his family on a ranch, owns a few hectares of land on which he plants various vegetables and which he then later sells. His personality attributes are seriousness, open-mindedness, and a drive to explore new things.
Regarding user goals, John uses this information system to become more aware of the impact of social media on his farm business. Furthermore, he wants to share information for other farmers but also for non-farmers that are interested in seeing farm-related information. Lastly, he enjoys the fact that he can address a wider range of consumers and customers through social media.

Scenario 2 - New production is ready to be harvested and sold to customers: It's Monday morning and John is ready to harvest and sell his production. He wants to promote his agricultural goods and find some customers that are interested. He takes pictures of the production and then uses the "tool" to create a post in the form of an announcement. He uses one of the templates provided by the tool and decides to post in on several different social media platforms. He also schedules other posts to be shared the following days as he knows that he will not sell his products in one day. He then waits to be contacted by customers.

6.2 Wireframes (functional and non-functional requirements)

Using the information found during the literature review and from interviewing farmers, we have compiled a list of functional and non-functional requirements to be included in the tool. The table can be found in Appendix B. We divided the functional requirements into four groups as follows: administrative functions (authorization), user requirements, system requirements and business requirements. This division was taken from ReQtest (2020), "a cloud-based test and requirements management tool". Furthermore, for each of the requirements a wireframe was created using Adobe XD, a vector-based user experience design tool for web apps and mobile apps.

Following, we will describe each category one by one, starting with the administrative functions. In this category we have included a sign up and an authentication functional requirement (see Figure 9), in order to ensure protection and traceability of the farmer's account. With regard to the sign up functionality, as a non-functional requirement the system should create an account for the user and send a confirmation mail within three minutes. Whereas for the authentication part, the system should connect the user to his profile within three seconds when the login button is pressed. These two features were included since they are standard aspects in the creation of mobile and computer applications (ReQtest, 2020) and to ensure safety of users' information (Lucas, Singh

and Henmi, 2006). The last functional requirement included in the administrative category was the link to all of the user's social media accounts. More specifically, to connect all farmer's social media accounts to the tool by using his email address. This was done in order to help the farmers keep track more easily of all his activity on social media and because of what two of the farmers mentioned during the interview about having an administrator part that handles all the information from social media. When we created this feature, we focused more on the farmers' own posts, even though they discussed the administrative part from the perspective of the content they see online. Furthermore, it was also believed to be necessary because of the lack of time farmers have to spend on using social media.

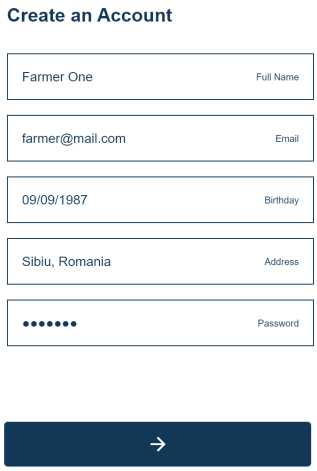

Figure 9. Sign Up page wireframe

In the next category, called user requirements, we have added six functional requirements. Firstly, through the "create a post" functionality, we addressed the necessity to ease the process of creating content for social media platforms. In this case, the non-functional requirement would be characterized by the following factors: a user-friendly interface from where farmers can create posts easily, a list of templates that farmers can use when creating a post and a division of the templates based on the four categories of farm-related information (see Figure 10).

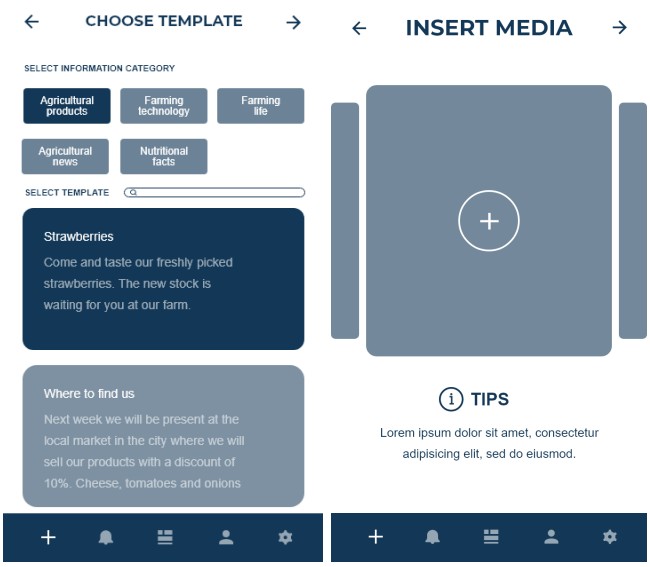

Figure 10. Choose template and Insert media wireframes

Secondly, we also thought about adding value to non-standardized products as mentioned by one of the farmers during the interview through the “insert media” feature. Here users will be provided with the option to insert an image or not to their post and they will receive hints about whether they should include an image or not based on the template or the platform they chose.

Thirdly, we addressed the time-related problem faced by farmers again through the schedule of the posts feature. By using this function, the system will allow the user to keep track of his posts and make sure that he maintains a regular posting habit. Their relation with customers is also taken into consideration here because the more posts farmers post online, the more people can be attracted to their business. Here users will be provided with a calendar which they can use to plan their posts to be shared on any selected day. Furthermore, the tool will use ratios, suggest suitable times to share the post and will send a notification when time is close.

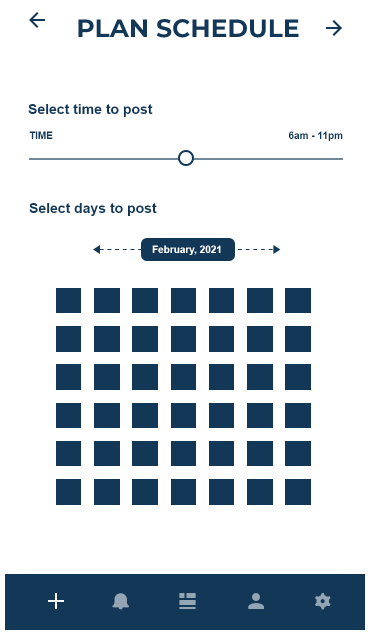

Figure 11. Schedule post wireframe

The fourth and fifth requirements are related as both of them ensure high-quality content that is correct and maintains a high standard. Furthermore, they are strongly related to the misinformation problem faced by farmers on social media and farmers' desire for grammatically correct posts. Thus, through the information check feature, farmers would be able to send their posts to a pool of authorized persons from the agricultural industry that will check their posts for accuracy. Whereas for the grammar check feature, the text would be analyzed by existing grammar tools which could be included in the tool. When a user would select the option to have his text checked for spelling, the integrated tools would automatically analyze the text and would suggests the changes needed. It is worth mentioning that in the final working version of the prototype used in this research, these features were not included.

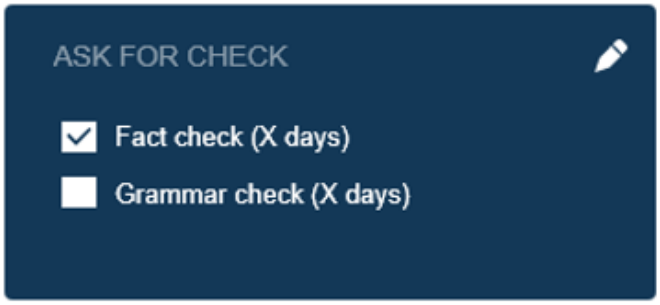

Figure 12. Misinformation and grammar check wireframe

The last functional requirement ensures that the farmer addresses the right audience. Users will be able to manually select the platform on which they want to share their posts on, but they will also receive suggestions for suitable platforms based on the template chosen or location from where he posts. This functionality was included because during the interview a farmer mentioned that sometimes it is difficult to know “which platform tells the right story”.

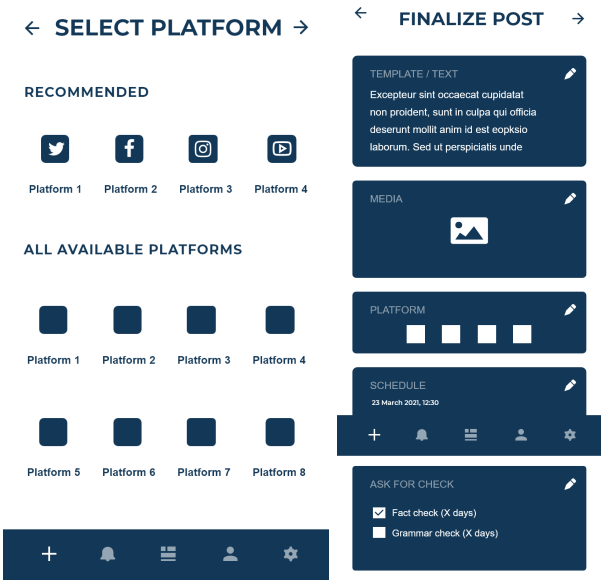

Figure 13. Platform selection wireframe and Finalize page

In relation to the system requirements category, we have compiled three functional requirements. The first two are related, both informing the user about actions that need to be performed. For the first one the system will send a notification to the user through which it informs him about the answers they receive and if their posts have been checked for misinformation or grammatical errors. For the second one, users will receive a notification prior to when the time is right to share a post. Through the third requirement, the system helps the user to keep track easily of his activity on social media as mentioned above. By analyzing their synced data from their social media accounts, the system will create a visualization of the data that will be easy to interpret by the user.

In the last category, we address the business requirements such as attracting more customers and adding value to non-standardized products. The first is accomplished

through scheduled (regular) postings and templates, while the second is accomplished by suggesting whether or not to insert media to the post.

6.3 Templates

As mentioned before, we have decided to include a template selection function/feature in the tool to ease the process of creating social media posts. In order to create suitable templates for the tool, we have conducted an analysis on social media in which we looked at the social media network and metrics of different farmers or farm-related organizations accounts on Twitter.

Given that there are a multitude of social media metrics that one could take into account when wanting to see how their content performs on social media (Peters et al., 2013), we have decided to focus on only a few of them. More specifically, we have looked into the number of posts (Chen, Fay, and Wang, 2011), number of likes (De Vries, Gensler and Leeflang, 2012) and the betweenness centrality, or the shortest path in network (Mallapragada, Grewal, and Lilien, 2012). Furthermore, we have searched for Twitter accounts that included the hashtags #ag, #agriculture and #farm in their posts. This was done similarly to a research from 2017 in which all tweets using the hashtag #MPNSM were analyzed in order to see the social media metrics related to a rare type of cancer community (Pemmaraju et al., 2017).

Firstly, we searched for farmers and farm organizations accounts using the hashtags previously mentioned. Then we applied the betweenness centrality by looking for similar accounts that were suggested by the platform. By doing these, we have extracted a list of 29 Twitter accounts, with a follower count ranging from 695 to 687,6K. We then applied a filter for each of the accounts. In this filter we specified that we wanted to see only the posts that would have at least 50 retweets, 50 replies or 50 favorites to be sure that we received only the content that received feedback from other users. An example of a post that we used to create our templates is shown below in Figure 14.

Figure 14. Example of Twitter post used for template creation

By applying all these methods, we have created in total 28 templates (see Appendix I) that we included in the tool. The templates were translated to Romanian and sectioned based on the four categories discovered during the literature review. Thus, we had 11 templates for the agricultural products category, 4 templates for farming technology, 9 templates for farming life and 4 templates for agricultural news. While some of the templates could have been used directly, some of them had blank spaces and others had multiple alternatives for different words. Here are a selection of the templates that were created:

- Contrar spuselor veganilor, carnea produsa la ferma noastra provine de la animale crescute prin cele mai naturale si sustenabile metode. Sunt sigur/a ca oricine vine in vizita la ferma noastra va fi de acord cu ceea ce spun dupa ce vede animalele. (EN: Contrary to what vegans say, the meat produced on our farm comes from animals raised by the most natural and sustainable methods. I am sure that anyone who comes to visit our farm will agree with what I say after seeing the animals.)
- Astăzi, împreuna cu ..., voi folosi tehnologia pentru … agricola in timp ce ne bucurăm de peisaj și pasarelele zboara deasupra noastra si ne incanta auzul. Am cea mai frumoasă meserie din lume! (EN: Today, together with ..., I will use the technology for …. while we enjoy the scenery and the birds fly over us and delight our hearing. I have the most beautiful job in the world!)
- Unii dintre noi vad frumusetea intr-un teren gata arat/prelucrat, in timp ce altii asa ca mine o vad in plugul/alta masina pus in functiune/la treaba. Poate ca e bine totusi ca vedem lucrurile diferit, nu? (EN: Some of us see beauty in a ready-made / plowed field, while others like me see it in the plow / other

machinery put into operation / at work. Maybe it's good that we see things differently, isn't it?)

Given that the posts from which we created the templates were selected based on a few criteria as previously mentioned, we have decided to translate the posts and make only minor changes to some of them. These changes were made in situations where words could have been replaced so that we transformed the template into something a bit more general that could be used by different farmers.

We have noticed that posts that are written in a more personal and positive note are perceived better by the audience, such as the post about the farmer who said that he loves his job. Furthermore, people enjoyed when the farmers were transparent and presented their practices in a blunt manner. It can be said that farmers and organizations who were genuine and straightforward in their posts influenced the users into generating more engagement to their content.

7. Usability Testing

In this section we describe the usability testing conducted on the wireframes presented in Chapter 6.2 and the results that were found. The insights extracted from this testing session were then incorporated into the working prototype version of the application.

7.1 Method

The goal of this usability testing was to find out if participants were able to complete a list of tasks successfully and to see what problems were present in the user interface. This was needed in order to identify the changes needed to improve the user performance and satisfaction. Furthermore, the participants were also asked to think aloud during the testing session. According to Nielsen (1993), a think aloud protocol is the most valuable usability engineering method because it allows us to discover what users think about the design and what kind of misconceptions they have about it. Follow up interviews were conducted to get more insights into how participants perceived the user interface and to see what they believed to be the problems with it.

Following the recommendation from Nielsen (2020), 5 participants (non-farmers) were recruited for this usability testing session based on convenience sampling. There were no requirements needed, only for them to be over 18 years old. An information brochure and a consent form were handed to participants prior to the session.

When it comes to the tasklist, there were in total 9 tasks that participants had to perform. The tasks (see Appendix C) were created following the 3 writing tips from the Nielsen Norman Group. As a result, we tried to make the tasks realistic and actionable while also avoiding giving clues and describing the steps, as McCloskey (2014) suggests. Furthermore, the tasks were also created based on the UI elements and the concept features that the application could provide. Thus, participants were firstly asked to perform short tasks (no. 1 to 5) related to the steps involved in the post creation through the application. Afterwards, they were asked to perform tasks in relation to posts that were already created (no. 6 and 8) and tasks about their user pages (no. 7 and 9).

The tasklist and the wireframes from Chapter 6.2 were imported into Maze.co, a remote testing online platform. After participants completed the tasks, they were asked to answer 5 questions (see Appendix D) about the interaction with the interface and their opinion about it. The results from the usability testing and the short interviews were then to be used in the next iteration of the prototype.

7.2 Results

As mentioned before, in total there were 5 participants for this usability testing session. The age group of four of the participants is 18 to 29, while the fifth participant is 43 years old. When it comes to sex, three of the participants are males and two are females. All of the participants used a smartphone or laptop daily (similarly to farmers), and none of them were involved in the farming industry.

Completion time

In Table 1, the completion time for each of the tasks is presented per participant. The completion time is measured in seconds. The last column, “Avg. time (s)”, shows the average completion time per task.

Table 1. Completion time of each task

Participant \ Task	P1	P2	P3	P4	P5	Avg. time (s)
T1	43.6	53.6	188.8	22.6	27.8	33.6
T2	9.2	11.5	30.9	19.6	12.4	5.6
T3	7.7	24.4	39.5	11	19.8	10.2
T4	8.2	10.3	31.7	5.7	12.4	6.8
T5	66.1	47.2	77.4	14.5	42.2	24.7
T6	46.6	32.9	51.2	20.3	18.1	16.9
T7	21.4	16.5	50.9	10.6	18.5	23.6
T8	7.5	9.5	29.3	2.9	10.8	12
T9	1.9	7.5	7.8	5.3	5.5	5.6

Misclick rate

For each of the performed tasks, misclick or error rate were counted by Maze automatically and a report was generated afterwards. Results are presented in Table 2. The last column, “Misclick rate (%)”, shows the average misclick rate per task.

Table 2. Misclick/error rate of each task

Participant \ Task	P1	P2	P3	P4	P5	Misclick rate (%)	Intervention
T1	9	12	5	4	2	80	1
T2	0	0	1	3	0	13.3	0
T3	1	0	2	1	2	40	0
T4	0	0	0	0	0	0	0
T5	0	12	0	4	1	30	0
T6	1	11	2	12	3	70	1
T7	0	5	0	2	1	60	1
T8	0	0	1	0	2	40	0
T9	0	2	0	0	0	20	0

Summary interview

For each question asked during the interview, a short summary of the answers received is given below. Afterwards, we also present some additional comments made by a few of the participants.

In general, what are your impressions of the application and why?

Overall, participants' impression about the prototype is positive. Most of the participants believe that the application can be useful for sharing posts on multiple platforms at once in a fast manner. For instance, they also perceive it as being easy to learn but mention that some of the parts require minor improvements. Two of the participants consider the "fact / grammar check" feature as being an essential part of the application because they also struggle with misinformation on social media.

Participant 5 mentioned "The application might be useful when the user wants to share / sell or post on different platforms. It's easier to learn with only one simple app."

How would you describe the process of completing the previous tasks? Why?

All participants considered that it was easy to complete the tasks, however, some of them found the process a bit confusing at the beginning. Because they did not have previous experience with usability testing, the procedure was found a bit unclear. It became much easier when they realized what they needed to do. One of the participants even mentioned that they were expecting the testing to be longer and boring, but they were pleasantly surprised to see this was not the case.

What do you think can be improved regarding the application?

The most important improvement mentioned by most of the participants is to change some of the buttons. Participant 1 suggested that it can also be helpful to add a description label below each button. Another recommendation is to move the “check” feature outside of the Finalize page (see Figure 13) and have a separate button with those options. Lastly, two participants said that it could be helpful to have a short introductory tutorial after installation on how to use the application.

Was there something that you found confusing about the application? If yes, please describe.

Most of the participants find some of the menu buttons (see Figure 15) confusing. For example, Participant 1 had some struggles with finding the newsfeed page because he did not find the button icon (button number 3 from Figure 15) representative for a newsfeed. He did say, however, that once he knew what the button meant, having that button icon for a newsfeed felt right. Furthermore, Participant 3 indicated buttons should align with the sequence of actions: “For me, it’s more natural to select the platform, and then the time to post”. Thus, it made more sense to have the “Select platform” feature button before the “Schedule post” button (see Figure 15).

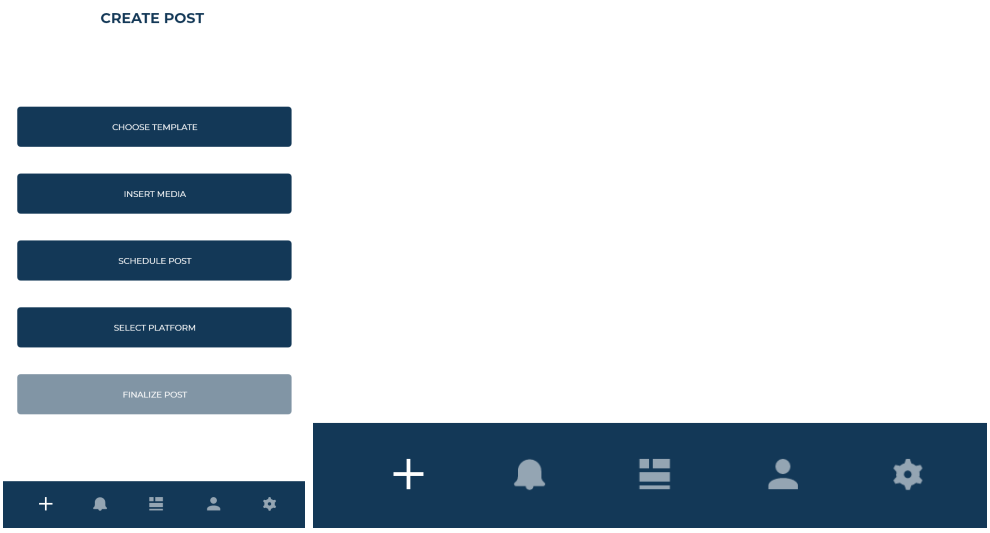

Figure 15. Menu buttons

Were there any difficulties in performing the tasks? If yes, please describe.

Overall, participants did not encounter any major difficulties in performing the tasks and they managed to complete all tasks. Some mentions that can be made here are the fact that Participant 2 was a bit confused about the difference between “grammar check” and “fact check” and Participant 5 found the most fitting platform to be Facebook and not Twitter. In addition, for the first task participants found it a bit hard to understand what they were asked to do and they had the tendency to press other buttons instead of the “choose template” button. For the first task there was an intervention as one of the participants could not really understand what was meant by “sharing information”. We then explained to him what we wanted to achieve through “sharing information” and then the participants knew what he had to do. Therefore, in this situation it might have been a problem in the way the task was formulated. Another intervention took place at task 6 as one of the participants could not find the newsfeed button as previously mentioned. We then hinted to the participant which might be the button and he managed to finish the task. The last intervention was for task 7 when another participant could not find the “User page” button. Similarly to the previous situation, we gave a hint to the participant which might be the button.

Interpretation of the results and what improvements need to be made

From Table 1 showing the completion time for each participant and each task, we can see that tasks 1,5,6, and 7 require some improvements as these require more time to be completed. It is worth taking into account that the times necessary for performing the activities was also influenced by the think aloud protocol.

Values from Table 2 regarding the misclick rate, show that tasks 1,6 and 7 require the most improvements and assistance. As mentioned before, participants were a bit confused (by some of the tasks) by the way the first task was formulated. When they were explained what the templates were referring to, they immediately understood how to complete the first task. For task 6 the time for completion and the error rate were higher because the menu button icon was not representative enough for some of the participants to see it as a news feed button. A similar situation was for task 7, where Participant 2 had some struggles with the menu button icon. In Participant 2's opinion, the button was similar to the “Friends requests” requests button from Facebook and it made the participant confused.

For the other tasks, some minor improvements could be made to the interface in order for the process to go smoother and with error-free. For task 5, Participant 2 had the highest misclick count because she believed “reliable information” was correlated more to grammar check instead of fact check. On the other hand, for Participants 4 and 1 the problem was that in the first instance, they were not expecting the fact/grammar feature to be included in the “Finalize post” section. For task 3, it was not necessarily a problem in the way the application was designed, but more about the default option for the most fitting platform that was presented in the prototype. Lastly, two of the participants encountered some minor problems with the “notifications” menu button icon.

Overall, even though participants had a positive attitude towards the prototype and they managed to complete the tasks, some improvements can be made in the design of the application. These improvements would be focused especially on the menu button icons and on the “grammar/fact” check feature position. Some of these changes will be implemented in the next iteration of the prototype, which will then be tested by some farmers.

8. Working Prototype Testing

In this section I present the high-fidelity prototype version of the tool, the testing session that was conducted with the farmers and the content that was generated during this testing.

8.1 High-Fidelity Prototype

A high-fidelity working prototype version of the tool (see Figure 16) was implemented using Adalo, a no-code development platform for mobile applications. The prototype was improved based on the findings from the usability testing, but because of time constraints and the limitations of Adalo, not all features were implemented. Thus, the content check, platform selection, newsfeed page and link to all social media accounts were not incorporated in this iteration of the prototype. However, we decided that the final part of the research is more focused on the content generated by farmers and how it is perceived by non-farmers (RQ 5), the necessary requirements (i.e. template selection, media insertion and post schedule) were included in the testing. For the "Schedule post" requirement, manual reminders were sent to the farmers at suitable intervals, prior to post creation.

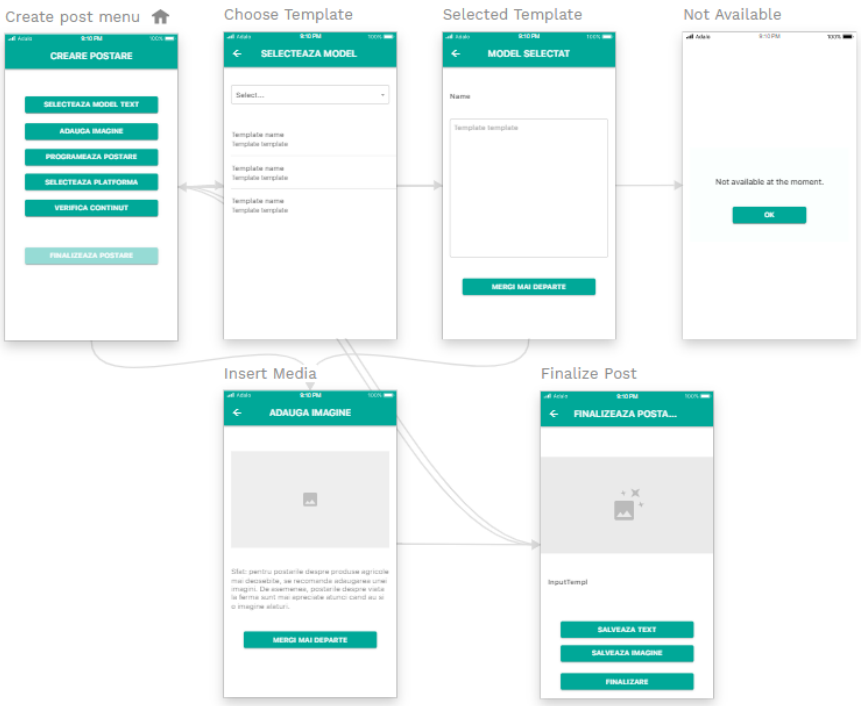

Figure 16. High-fidelity prototype in Adalo

Figure 17. “Create a post” menu

It is worth mentioning that the language used in the working prototype was Romanian because the testing was conducted with only Romanian farmers and thus it was easier for them to follow the steps. In Figure 17 we can see the “Create a post” menu that was shown to the farmers when they first opened the application. From here, the users could go and select a template for their post, insert an image or go to the finalize post page. When the first option is selected, the user is presented with the “Select template” screen (see Figure 18), where the templates can be filtered based on the four categories of information found in the previous chapters. After a template is selected, another screen opens in which the user can see the entire text and make edits to it.
Next comes the “Insert media” screen (see Figure 19) where the user has the possibility to add a picture to the template he previously selected or created. When the button is pressed, the user has the option to import a picture from his gallery or he can open the camera and take a picture on the spot. Furthermore, on the “Insert media” screen, the user also sees some tips regarding adding pictures to the farm-related posts.

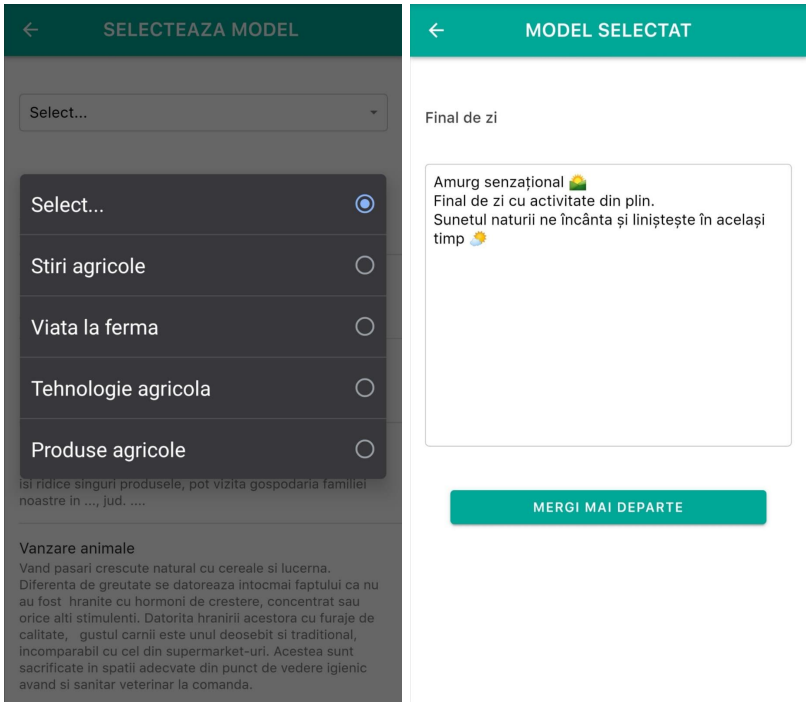

Figure 18. Template selection workflow

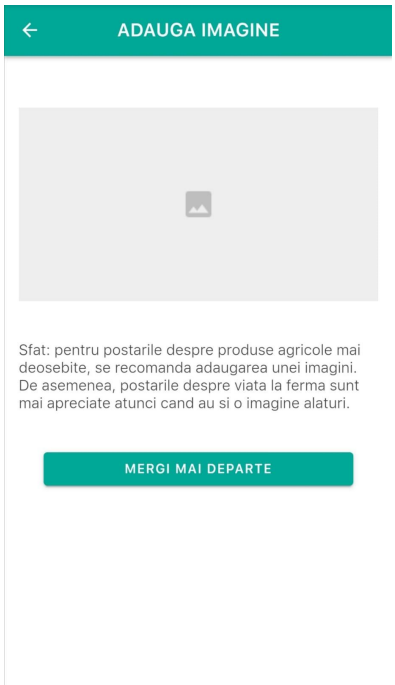

Figure 19. Insert media screen

Lastly, after the text is created and the picture is inserted, the user sees the “Finalize post” screen. Here, there are 3 buttons as follows: “Save text”, “Save image” and “Finalize post”. By pressing the first two buttons, the post is created and saved in the Adalo database so we can furtherly process it and use it for the following section. By pressing the “Finalize post” the user is taken back to the first page.

8.2 Prototype Testing With Farmers

In total, a number of 5 farmers took part in the prototype testing and creation of posts over the course of one week. From these, three farmers were focusing their agricultural business on vegetables, fruits and cereals, while the other two were growing and selling animal products. Prior to the testing, an information brochure and consent form were handed to them (see Appendix G). Farmers were told to firstly create two posts without using the tool during the first three days of the testing period. The posts did not have to be shared on their social media accounts, but they had to be submitted as a private message.
After the first two posts were created, the prototype was given to the farmers alongside with a short description of the application and its usage. Furthermore, based on the first two posts they created, they were further instructed to choose templates from the two categories that best fitted their farm and content. This was done in order to ensure that the posts created with the tool were on the same topic as the posts created without the tool. Thus, in the next three days, farmers created two posts with the help of the tool. It was necessary to send only a reminder for the second post on the sixth day, as the first post was created on the fourth day immediately after they received the tool.

During the last day of the testing, a short semi-structured interview was conducted to find more qualitative information about farmers’ opinion regarding the tool and the experience of using it for creating posts. The focus of this interview was to find out if the tool indeed helped the farmers during creation of posts and if it made the process easier for them. The interview contained 4 open-ended questions and one close-ended question (see Appendix F). The interview started with a question about farmers’ impression regarding the application in order to get an insight into their general opinion about the tool. Next they were asked to compare the process of creating a post with and without the tool to see if they perceived any differences between the two conditions. Questions three and four were included to see which of the features implemented in the prototype were helpful and which were not. Lastly, the close-ended question was used to see if the farmers were interested in continuing using the tool.

8.3 Findings and Generated Content

As mentioned above, neither the posts created without the tool nor the posts created with the tool were shared on farmers' social media accounts. The first two posts were saved privately in a message while the last two posts were automatically saved in the database of the application. Using the information provided by the farmers regarding the four posts, fake Facebook posts were created using a platform called Zeoob. Only the text and image provided by the farmers were used for the posts and any other personal information that could be linked to them was deleted and replaced with fictitious information. Because of this, all the posts looked as if they were shared by the same account.

In total, participating farmers created 20 posts (see Appendix J), 10 through the tool and 10 without the help of the tool. An example of two posts created using the information from farmers is presented below in Figure 20. Overall, the posts created were part from the categories agricultural products and farming life. To be more specific, farmers created posts about their farming experiences and how much they enjoy their business, but also about how their products are growing and what they are selling. This was most likely due to the fact that the harvesting season started for some of the farmers and the sprouting season for the others.

As mentioned before, farmers were instructed to create posts on the same topic in order to be able to better analyze the responses from non-farmers. Thus, in the figure shown the post on the left was created by a farmer to talk about his location availability and the products he sells, while the right post was created using a suitable template from the tool that talked about the same topic. A translation of the posts is added in the Appendix E and in the figure caption.

One of the differences between the posts created with the tool and those created without the tool is that when some farmers created the posts on their own they included a few minor grammatical and punctuation errors (such as post 19 from Appendix). The length of the posts sometimes also differed, as the farmers had the tendency to write in a shorter paragraph their idea, while when they used the template the same idea was presented with more words (i.e. post 8 and 17). Lastly, it seemed that farmers included more emojis in their posts compared to when they used the templates.

We have also noticed that farmers used the templates as they were provided, making minor changes, with one exception when two of the farmers changed the template entirely while maintaining the same idea of the post (i.e. post 1 and 6). Farmers also chose and employed different templates, besides the situation cited above, in which the

farmer almost completely changed the template. Another farmer, however, chose the identical template and opted to use it as it was provided.

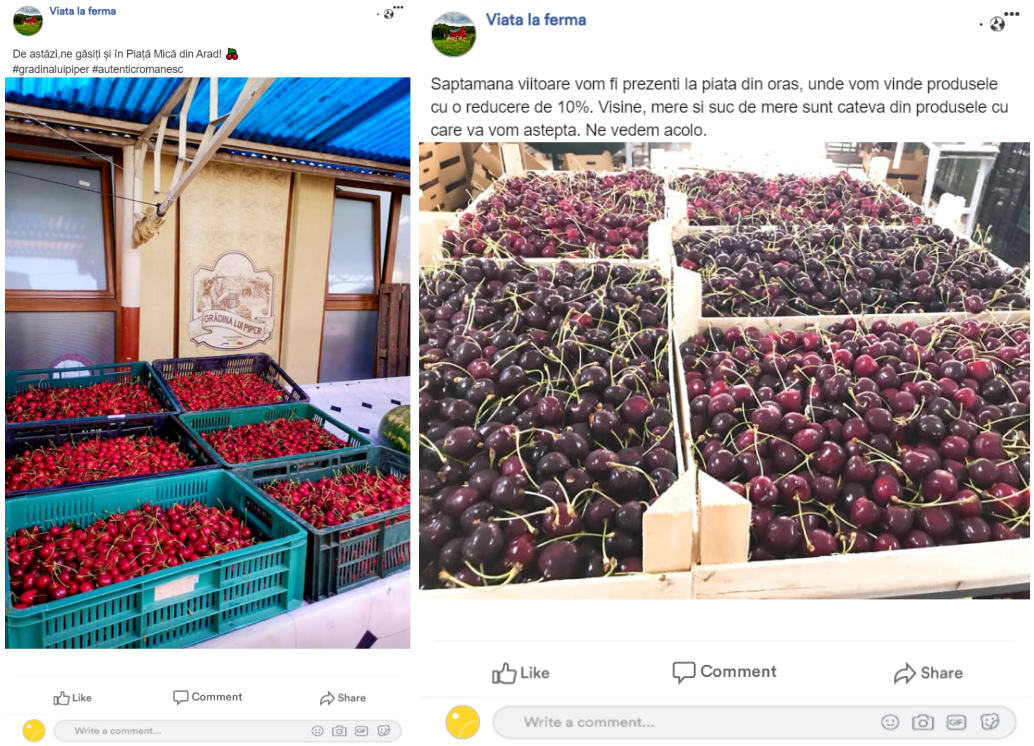

Figure 20. Example of Facebook posts created without the tool *(left)* and with the tool *(right)*; Translation: From today, you can find us in the small square in Arad. #Pipersgarden #authenticromanian *(left),* Next week we will be present at the market in the city, where we will sell the products with a 10% discount. Cherries, apples and apple juice are some of the products we will be waiting for you. See you there. *(right)*

8.4 Summary Interviews

A brief overview of the responses received for each question posed during the interview is provided below. The interview was conducted in Romanian, and the questions and responses were then translated into English for the report.

In general, what are your impressions of the application and why?

Farmers, on the whole, are enthusiastic with the tool they utilized during prototype testing. The majority of them think it is a useful tool that is well-structured and simple to

use. Even though he uses a number of tools to monitor and control his internet activities, one of the farmers expressed excitement about this new tool that allows him to generate social media postings for his farm.

> *How would you describe the process of creating a post using the tool compared to creating a post without it?*

Judging by the answers received to this question it can be said that there are two main opinions coming from the farmers. Three of them consider that the process is easier, simpler and faster when using the tool. The application, as one of the farmers said, provides explanations at each step of the process and attractive templates for when you are out of ideas. The other two farmers, on the other hand, believe there is not much of a contrast between the two techniques because they both require some sort of effort.

> *Which of the elements (i.e. template selection, media insertion, reminder) from the prototype do you consider to be helpful in the creation process? And why?*

Regarding this question, farmers found the three elements of the prototype almost equally helpful for post creation. Given that only one reminder was sent, it might be claimed that template selection and media insertion were seen as being more beneficial than the others. One of the farmers even suggested that given that agriculture is such a vast domain, more diverse templates could be added to the list.

> *Which of the elements (i.e. template selection, media insertion, reminder) from the prototype do you consider to not be helpful in the creation process? And why?*

As mentioned before, the reminder was perceived as being a little less helpful than the other two elements. In addition, one of the farmers said that template selection might be perceived as a bit troublesome for older farmers. This was highlighted because he believed they might require additional assistance in selecting an appropriate template, but that this could be solved with a brief explanation when they first started using the program.

> *Would you be interested in using this tool from now on?*

In response to the final question, all of the farmers stated that they would be willing to use the tool in the future. One of them expressed interest in adopting it since it allows him to advertise his farm business via digital means, which is critical in this modern day.

Another person responded more succinctly, saying they want to use it because it is "simple, fast, and easy to use."

9. Tool Content Evaluation From Non-Farmers' Perspective

In the following chapter, the user study in which a survey containing the posts created by the farmers during the high-fidelity prototype testing is presented. Afterwards, the results are presented and analyzed in order to determine whether there are differences between participants' consumption and contribution of the posts created without the tool and those created with the tool.

9.1 Method

In a similar manner to the first survey, when it comes to the participants the requirements were that they were over 18 years old and non-farmers. Participants were recruited using two of the methods used before, through convenience sampling and snowball sampling. Thus, the survey was shared on the Facebook group dedicated to Romanian students from the University of Twente and also to acquaintances, which in turn shared it with other acquaintances of their own. The survey was created in Qualtrics and it was available for four days. We decided it was realistically attainable to have a sample size for the survey of 40 participants. The survey started with an informed consent (see Appendix G) in which participants were given information about the research. Next, we included a section with questions about demographics, similar to the first survey from this research.

The purpose of this survey was to find out whether there were differences in the way non-farmers engage with the content created by the farmers during the previous stage of the research. More precisely, we wanted to find out if the templates created actually had an influence on non-farmers and if the posts created with the tool performed better than the posts created without the tool. The same COBRA scale was used to design the questions for this survey, however there were some slight differences between the first and second surveys. For the "consumption" we added a question about reading, watching and following farm-related posts, while for the "contribution" we included a question about liking, sharing and commenting.

We can assume that by using questions created based on the two COBRA types we would be able to analyze the way participants engage with the posts created by farmers in the previous section. Thus, the following matrix question was created and inserted after each post presented in the survey:

(Consumption)

1. I enjoy reading this post.
2. I enjoy watching this post.

3. I want to follow this post.

(Contribution)

4. I want to like this post.
5. I want to share this post.
6. I want to comment on this post.

After each item of the matrix question we included a 5-point Likert scale (1 - Strongly disagree, 5 - Strongly agree) similar to the one used in the first survey. Participants were asked to express their level of agreement with each item of the matrix question from 1 to 5, 1 meaning strong disagreement and 5 strong agreement. A neutral option was added in the middle.

9.2 Results

In total, there were 83 participants who agreed to fill in this questionnaire. However, 6 responses were not complete and were missing values, thus these were removed and in the end there were 77 participants, from which 46 females and 31 males. Almost half of the participants (36) are between the ages of 18 and 29, 32 are between the ages of 30 and 49, and 9 are between the ages of 50 and 64. The questionnaire included no participants over the age of 60.

According to the participants, Whatsapp and Facebook are the most used social media networks they use at least once a week in response to question 3. 64 and 63 people, respectively, chose these two platforms. YouTube comes next, being selected by 49 of participants, followed by Instagram. Ten and nine individuals, respectively, chose Snapchat and LinkedIn. Finally, both Twitter and blogging services received three votes each. TikTok, Reddit, and Signal were among the other three platforms named by participants.

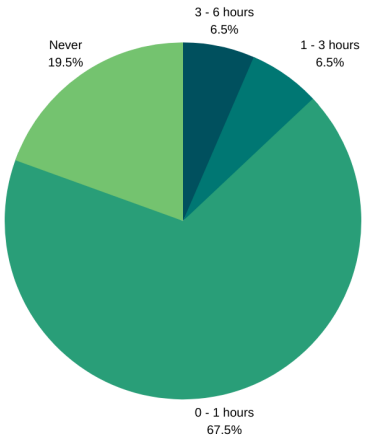

Figure 21. Work hours spent on social media per day

On average, participants spend more hours on social media platforms during their free time than during work hours (see Figure 21 and 22). 67.5 percent of respondents spend around 1 hour of their work time scrolling on social media, while 19.5% do not access these platforms during work time at all. On the other hand, almost half of the participants (46.8%) say they spend between 1 to 3 hours on social media everyday, while 35.1% spend a maximum of 1 hour per day. An equal percentage of people (1.8%) declare that they either spend more than 6 hours of their free time on social media or they do not access these platforms at all. In contrast, an equal number of people (6.5%) report they spend 1 to 3 hours or 3 to 6 hours on social media during work hours. Finally, 15.6 percent of participants use this technology for 3 to 6 hours in their spare time.

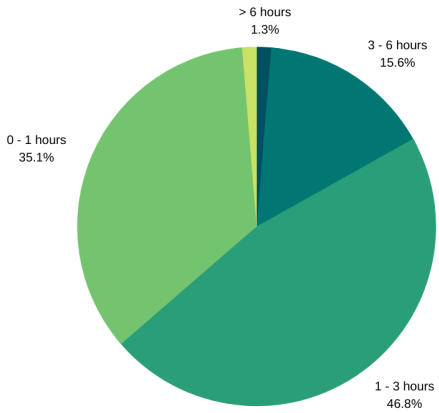

Figure 22. Non-work hours spent on social media per day

Our null hypothesis and the alternative hypothesis for the second survey are as follows:

H_0: "There is no difference in participants' consumption and contribution of farmers' posts created with the tool versus posts created without the tool."

and

H_1: "There are significant differences in participants' consumption and contribution of farmers' posts created with the tool versus posts created without the tool."

In order to test this null hypothesis, the data was prepared and a statistical test was conducted in SPSS. Similarly to the first survey, an exploratory analysis was used and the responses from participants were averaged after Cronbach's alpha was calculated and the Principal Component Analysis was performed. For the first we had a value of .808 while the second analysis suggested that we should extract one component, thus we had the statistical support to proceed further. Because of the results mentioned before, the responses received for the 6 items from the matrix question were averaged, in order to have one component for nonfarmers' consumption and contribution. Moreover, these values were then averaged again by making an overall average value for all the posts the participants saw in one condition. Thus, in the end we had two averaged values (see Appendix H), one per each condition (i.e. seeing posts made with the tool and without the tool), which were then analyzed. We have decided to analyze the responses in this way because we have assumed that when results were averaged they were close to normally distributed interval data. Even though according to Lazar, Feng and Hochheiser (2017), Likert scale is seen as ordinal data, because we have averaged the responses and thus had a normally distributed interval data, we have selected the paired samples *t* test for this analysis. In our case, the independent variable is the social media post and the two conditions are the way the post was created (i.e. with and without the tool).

For our data, the p value is 0.008 for t(76) = 2.71, the mean difference 0.08117 (3.6390 mean for posts without tool, 3.7201 mean for posts with tool) and standard deviation 0.26269. The correlation between the two means is 0.926. Judging by these values, we can say that there is a statistical difference between the two conditions and the two means are positively correlated. On average, the posts created by farmers through the help of the application scored higher on the COBRA scale compared to the posts created without the tool. Thus, we can assume that the tool had an influence over the posts since participants' consumption and contribution was higher in this case.

Furthermore, we also did another exploratory analysis where we averaged the responses from all of the participants per each question. Here we have noticed that the post created by one of the farmers with the help of the tool had the highest score (see post 8) with an average value of 3.88, but another post created with the help of the tool had the lowest score (see post 4) with an average of 3.25. The latter could have happened because of the picture the farmer used which as it can be seen is not visually very pleasing because of the font used in it. The following posts that were consumed and contributed better by the participants were the posts about the apple juice and the trip to the farm (see posts 7 and 19). We have also noticed that a post about cereals which included a picture with the field had lower values (i.e. post 15), while a post about the farmers' joy but which also had a picture with cereals had higher values (i.e. post 16).

Overall, we have noticed that there were some statistically significant differences between the posts created with the tool and the posts created without the tool in terms of non-farmers' consumption and contribution. But we have also found that some of the posts created with the tool performed better than other posts created also through this application. However, this might have been influenced by the pictures included in the posts and not necessarily because of how the templates were created.

10. Discussion and Limitations

In this discussion section, we look at how we responded to each of the research questions presented at the beginning of the thesis, as well as the contributions this study brings to the field. Following that, we describe some of the limitations encountered during the research. Finally, we provide some recommendations for potential future research on this topic.

In this study we have made a tool to aid farmers in their process of creating posts for social media, building on findings from literature review (Chapter 2), surveys with non-farmers (Chapter 4) and interviews with farmers (Chapter 5). We did this by providing them with templates from four categories of information (i.e. agricultural products, farming life, farming technology, agricultural news) and by suggesting media use for some of the posts, such as those about unstandardized products. We recommend adding reminders in the tool in order to maintain a regular posting schedule. Beyond the current prototype created in this study, we encountered a wish for peer-review and expert corrections of the content, but also grammatical check. Furthermore, a platform suggestion feature was also conceptualized in order to assure that the farmers post their content on the most suitable platform. Although, in this current form, the working application is on a minimum level and only addresses some of the issues, there is potential in it especially if all of the features described in this paper are included in future iterations.

10.1 Research Questions Answered

Through this research, we wanted to gain more insights into the use of social media platforms in the farming industry. The analysis was conducted from two viewpoints: the farmer perspective and the non-farmer perspective. For this, the research questions described in the introduction section were analyzed and answered throughout the study. The outcomes for each of the research questions are described below along with the contribution to the research area.

1. *How does the type of information/feed influence non-farmers' consumption and contribution of farm-related information?*

To understand how non-farmers consume and contribute to farm-related posts on social media a survey was conducted. In this survey, four fake Twitter feeds were presented to the participants. Each feed described a category of farm-related information (i.e. agricultural products, agricultural technology, farming life and agricultural news) that farmers usually share on social media as found during the Research Topics.

Because there was a p-value of 0.237, results showed that there were no significant differences in how non-farmers consume and contribute between the four categories of information (agricultural products, farming life, farming technology and agricultural news) presented in the feeds.

These results could have contributed to the research area of farmers and social media by giving an insight into which information farmers could focus on when creating posts for their business accounts. Moreover, it could have helped by informing farmers which category of information needs improvement in order to attract more customers. However, given the results, we can suggest farmers to not focus on only some of the topics, but try to address all of the categories of information when posting online. Thus, as found during the literature review, farmers could create posts about farming life (Glaves, 2017), farm tours (SocialB, 2015; Hardesty, 2011), promotion of agricultural products (Allen, et al, 2012; Glaves, 2017; Vassiliadou, et al, 2011), nutritional information (Zhao and Zhang, 2017; Tobey and Manore, 2014), agricultural news and issues (McConnel, 2015; Prakash, 2020) or about farming technologies. For example, a farmer who grows vegetables could create posts about his products but also about the technology he uses or practices he makes to produce those vegetables. He could also describe his farming life by talking about his day, but he could also inform others about new information that he finds from other sources.

2. *How does the type of media presented in the feed influence non-farmers' consumption and contribution of farm-related information?*

For the second research question, the same survey from the first research question was used. The types of media analyzed were text and images. As previously mentioned, half of the respondents saw the text-only feeds, while the other half saw feeds with text and images.

Similarly to the first research question, for this one there was no statistically significant support either as the p-value was of 0.237. This means that the type of media did not influence non-farmers' consumption and contribution of the farm-related feeds that were presented to them.

Contribution wise, these insights can be used by farmers when they create posts for their business social media accounts. It can be useful for farmers to know whether to add a photo or not to their post as it can make the post creation process more easy. However, because of the results, we can only suggest farmers to include pictures if they already have them or if they have the possibility to create some. And as mentioned by

one of the farmers during the interviews, pictures could also be included when posts about unstandardized products are created. In this situation, it is more suitable to show through photos to other farmers and non-farmers what they are talking about exactly as these products are not usual and might not be known by everyone.

3. *How might the process of creating and sharing social media posts by farmers be improved?*

The third research question was researched by having interviews with farmers in which their social media related problems were discussed. Their usage and extra needs from social media were also explored. Furthermore, based on the findings from these interviews and using the information gathered until this step of the research, a tool was conceptualized. The purpose of this tool was to aid farmers in the post creation process by making it easier and faster.

We found out that farmers encounter different difficulties when using social media, some of which were also found during the literature review. We discovered that farmers find social media pictures useful for various reasons such as asking for information about a problem (i.e. Zipper, 2018; Amanatidou et al., 2012) or promoting their business (i.e. Allen, Abrams, Meyers, & Shultz, 2012). Farmers would like to have an administrator that would handle all the information that is presented on social media and that it would be useful if this information would be categorized. In case of issues, fast responses in maximum 24 hours from authorized people (i.e. university professors, engineers) are well received by farmers. Furthermore, a location-based feature that presents all available products to people on social media can be useful alongside with a “storage” that takes every information shared from producers. Lastly, there were also some extra types of information mentioned by farmers such as european funds or festivals related to agriculture and their promotion.

This research question provides more insights into how farmers use social media which can be used by specialists in the area. Agricultural experts who are also technology enthusiasts can think of solutions to the difficulties mentioned above. In the conceptualization phase of the tool, we have tried to provide some solutions for the problems mentioned by the farmers such as the misinformation which we tried to alleviate through a peer-review process. However, this along with others were not included in the working prototype of the tool (see Section 10.2). Other possible solutions that we recommend could be a special social media platform just for farmers where the information that they see would be sorted and categorized, or online lessons on how to use this technology. Furthermore, people from the domain could take these problems into consideration when deciding to include social media into the agricultural industry

more and by fixing these, more farmers could be drawn into using these platforms for their business.

4. *What impact does a tool created for farmers to create social media posts have on their creation process?*

The prototype tool created based on the findings was given to farmers for a week to test it and create some social media posts. As previously mentioned, this working prototype did not address all of the problems encountered by farmers, but only focused on making the process easier through template selection, by giving a hint regarding media insertion and by reminding them to post. After their testing session, an interview was held to get more in-depth information about their interaction with the application.

We discovered that farmers were enthusiastic about the tool and found it helpful, well-structured and easy to use. Compared to creating posts without the tool, some of the farmers believed that the process is easier, faster and simpler when using the application. The other farmers considered that both techniques require some sort of effort, thus they were pretty similar. Moreover, two of the three features (i.e. template selection, media insertion) included in the prototype were perceived as being equally helpful. The third one, the reminder, was not as helpful mostly because there was only one reminder sent during the testing session. Overall, all farmers perceived the tool in a positive way and were willing to continue using it.

As a contribution, these findings bring additional information about farmers' readiness to use auxiliary tools to boost their social media usage. Furthermore, the insights into their adoption and opinion of a tool that assists farmers in creating social media postings provide fresh data for the field, as this topic had not been investigated in this fashion before by other researchers.

5. *How does the tool influence non-farmers' consumption and contribution of farm-related content?*

The last research question was analyzed through a second survey that was distributed to non-farmers. The posts previously created by farmers with and without the tool were used here. This was done to examine whether there were differences in non-farmers' consumption and contribution between the posts created with the tool and the posts created without the tool.

Based on the results from the paired samples *t* test we discovered that the posts created with the tool scored higher on the COBRA scale compared to those created

without the tool. This also means that most likely the templates included in the tool were successfully selected and fulfilled their purpose to improve the consumption and contribution of farm-related content on social media.

These findings shed light on how auxiliar tools can assist farmers in creating social media posts that are more well-received by non-farmers. These discoveries can aid agricultural workers and company owners by giving them an insight that they can get the help they need for social media usage. Additionally, utilizing this application as a starting point, further technological tools could be constructed, which will take into consideration all of the problems encountered by farmers.

10.2 Limitations and Recommendations for Future Work

Initially the research focused on farming from all around the world. This was done in order to find out if farmers from all places encounter the same difficulties when using social media. As a first limitation, during the first interviews conducted with farmers, almost all of the participants were Romanian farmers and one was Dutch. This was most likely due to the COVID-19 pandemic, as it was more difficult to find available participants but also because of time issues as farmers are very busy with their business work. It is recommended for future research to interview farmers from different countries as they might encounter different problems with social media which can be taken into consideration when designing tools to aid them. Furthermore, there were only 6 farmers interviewed which can be seen as another limitation. Interviewing a higher sample of participants might bring more problems to light.

Similar limitations are present in the second interview and prototype testing with farmers. Besides the low number of participants, all of them were males and Romanian. This could insert some bias into the results as they might have similar digital literacy levels. Thus for future work it is worth testing the prototype on farmers from various places and see their interaction and opinion regarding the tool.

A limitation of the first survey, about the categories of information and type of media, could be that the vast majority of participants were Romanians (27 out of 54), with only a handful from other nations. It would be nice to find what non-farmers from all over the world think about farm-related content and see how they consume and contribute to such content. The age group of the participants is also another limitation, as more than half of the participants were in the 18 to 29 age group. Younger people might have different preferences in terms of the information they see online, but also about the type of media. It is possible that for older people it is more of a preference to see pictures more often than text as they might have eye problems and it could be difficult for them

to read too much text. There are also some biases generated here by the sampling approach used. Firstly, because participants were selected using convenience sampling, the sample might not be representative enough of the population being studied. Secondly, the results might have differed if all participants would have seen the feeds in both conditions. Furthermore, given the method used was a survey and because of technical difficulties, the media types analyzed in the survey were text and images. Video content might perform differently in terms of consumption and contribution as people sometimes prefer watching content instead of reading it. As a result, we recommend that future studies look at this form of media as well. Other types of farm-related information should be considered in future studies because they may reveal statistically significant differences.

Regarding the templates, not all of the categories of information were taken into account when we created them. As mentioned by non-farmers during the first survey or by farmers during the interviews, for future research, more templates can be created about the nutritional value of farm products, suggestions for recipes using the available products, preventing issues with activists or sharing funds and subsidies. These topics were not addressed in this research but they could be of importance especially for some of the farmers. For example, in case there are other problems with activists who complain about farmers' practices, templates designed in a polite and positive way could help the farmer in handling this situation. This could also strengthen the relationship between farmers and activists, as well as society, because people will notice that the farmers are not unreasonable and are considering the welfare of their animals as well as the opinions of others.

Lastly, even though we included all the requirements described in the conceptualization phase into the wireframes in the working prototype only three of them were used because of time constraints and technological limitations. This means that not the whole concept of the application was analyzed to see if it fitted the farmers' needs. For future work it would be recommended to include all of the features into a tool, especially the misinformation solution as this is one of the most important problems that farmers encounter on social media. By having their posts checked for misinformation by authorized people, it will be ensured that the information shared online is trustworthy. This will improve both the relation between farmers and non-farmers, but also between the farmers and other farmers. When a farmer, for example, tries a strategy he saw in a post posted by another farmer and sees excellent results, his faith in other farmers improves, and he is more willing to try other strategies he sees online. Similarly for non-farmers, if they read a post from a farmer about the nutritional values of the products and then they decide to buy them, they will be more inclined to go again to that

farmer to get more products if they know the information posted is true. This way, by developing trust, the gap between citizens and farmers could be reduced.

Furthermore, for media insertion even though we did not see significant effects in non-farmers' consumption and contribution, we have decided to provide an insight by including a hint under the add media button. A better approach would be to have the system automatically analyze the template selected by the user and based on that suggest to him whether or not he should add media. Another approach could be to have the templates analyzed through machine learning for specific words and then suggest whether to add a picture or not to the post. For example, if a farmer has a business in which he grows Wagyu cows, which has one of the most expensive meat in the world, then when he would create a post about his cows the tool will see that he added the word Wagyu and would tell him too add photos because it is an unusual and unstandardized product. Platform suggestion and calendar feature with recommended data to share posts should also be included in a future iteration of the prototype. By analyzing the location from which the farmer posts, the tool will suggest to him the most popular platforms used in that area.

Overall, the tool designed in this study to help farmers in the social media post creation process addressed some of the problems encountered by them, while leaving room for improvement for future research. It has been tried through the steps taken in this research and through this tool to minimize a bit the gap between the farmers and citizens, but also between the farmers and other farmers. This research can bring new information about social media and how this changes the practice of farming by analyzing both the farmer's perspective and the non-farmer's. It can be said that such a tool can improve the agriculture industry because through social media multiple layers can be addressed. For example, by reducing the misinformation on social media, farmers can more easily turn to other farmers on social media for help in case of problems. Moreover, by improving the relationship between farmers and consumers, the business part can also be improved as customers will happily buy products from farmers that are open and transparent on social media. When farmers share attractive and trustworthy posts, people are more likely to consume and contribute to those posts and in the end even buy the products they sell. Therefore, if a farmer has high-quality products and is given the proper help in using social media, only good things can happen.

11. Conclusion

In this research we have described how farmers use social media and the problems they encounter when creating posts for these platforms. We also looked into how non-farmers consume and contribute to the posts created by farmers on social media. Furthermore, we have analyzed how a tool designed to help farmers in the process of creating posts affects their process and whether this application improves non-farmers consumption and contribution.

There were five main steps in the process, beginning with a survey dedicated to non-farmers' consumption and contribution of farm-related content on social media. Interviews were held with farmers afterwards in order to study their usage of social media and the problems they encounter with it. Next we designed a tool with its purpose being to aid the farmers in the process of creating social media posts. A prototype of the tool was given to farmers to use and create posts for a short period of time. Finally, the posts created by farmers were included in another survey in which we analyzed how the posts created with the tool performed compared to the posts created without the tool in terms of non-farmers consumption and contribution.

The first two research questions about how the type of information and type of media influence non-farmers' consumption and contribution of farm-related content social media, were answered through the first survey in which 54 participants were included. From this we found out that there were no statistical significant differences in non-farmers' consumption and contribution of farm-related content on social media in terms of the categories of information and type of media presented. The third research question regarding the process of creating posts and can this be improved, was answered through the first interviews done with 5 Romanian farmers and 1 Dutch farmer. Based on these interviews, we discovered that farmers have some challenges with social media and that a tool meant to assist them in the process of making posts would be appealing to them. With the help of the prototype developed, we managed to answer the fourth question, about the impact of a tool designed for farmers to help them in the process of post creation. We found out that the 5 Romanian farmers who took part in the 1-week testing session had a positive attitude towards the tool and considered that it made the creation process much easier and faster. Furthermore, they were willing to continue using it from then on. The last research question about the tool's influence over non-farmers' consumption and willingness to contribute to farm-related content was successfully answered through the second survey in which the posts created by farmers in the previous stage were compared. In total, there were 77 Romanian participants in the survey and results showed that non-farmers' consumption

and contribution had higher scores for the posts created with the help of the application than the posts created without the tool.

Overall, this research not only sheds light on how non-farmers consume and produce farm-related content on social media, as well as the challenges farmers face while using the platform, but it also demonstrates a possible added value for a novel method to assisting farmers with the creation process.

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Appendix

Appendix A: Questions Interview Farmers

1. Do you have a social media account for your farm business?
2. Which social media platforms do you use?
3. How often do you use social media platforms for your farm business?
4. How would you describe your interaction with social media?
5. How do you make use of social media to connect with consumers/customers?
6. How do you connect with other farmers on social media?
    - Do you share information with them?
    - Do you maybe ask for help when you have a farm-related problem?
7. What kind of information do you usually share on social media?
    - Besides information about agricultural products, farming life, technology and agricultural news what other categories of farm-related information would you say there are?
8. Which is your preference when it comes to the type of media you share online? (i.e. photos, text, video)
    - Did you notice whether your followers have a preference in the type of media? Do posts with pictures get more engagement?
9. What do you think is missing from social media platforms when it comes to farm-related issues?
10. How do you think the interaction between farmers and social media can be improved?
    - Do you think a tool designed to help farmers post on social media will be beneficial for farmers?
    - Would you be interested in a tool designed to help farmers with using/posting on social media?
    - What would you like to be included in this tool?
    - How the tool should work? (i.e. an online website tool or a mobile application)
11. Would you be interested in testing it after a prototype is implemented?

Appendix B: Table Functional and Non-functional requirements

General/overall necessity	Functional requirement	Non-functional requirement	Rationale (where it comes from)
	Administrative functions - Authorization		

Ensure protection and "traceability" of the farmer's tool account	Sign up	The system should create an account for the user and send a welcome/confirmation mail within 3 minutes. → if email already in use, the system notifies the user	*Standard feature that is included in mobile/computer app development;* *https://clearbridgemobile.com/how-to-build-a-mobile-app-requirements-document/* *https://www.guru99.com/functional-vs-non-functional-requirements.html*
Ensure protection and "traceability" of the farmer's tool account	Authentication	1. When the login button is pressed, the system should connect the user to his profile within 3 seconds. 2. If user wants, the system memorizes his information and keeps him logged in.	https://www.sciencedirect.com/science/article/pii/B9781597490887500098 *Secure local communication (authentication, access control, encryption)*
Keep track more easily of all the farmer's activity on social media	Link all social media accounts	1. Connect / sync all farmer's social media accounts through his email address to the tool. 2. Add option to include social media accounts that are connected to other email address but belongs to the farmer as well (as some	From interviews with farmers: 2 of the farmers mentioned that there is an "administrator" missing from social media who handles the information; - Also because of time-issues it could be helpful if farmers could see all the stats about their platforms

		farmers have separate accounts for their farm and for themselves)	in one place.
	User requirements		
Ease the process of creating content for social media platforms	Create a post	1. Provide a user-friendly interface from where farmers can create posts easily. 2. Provide a list of templates that farmers can use when creating a post (database of templates). 3. Categorize the posts based on the 4 categories of farm-related information found.	Mostly because of digital literacy problems - Sayruamyat and Nadee, 2020; - But also because of the other issues combined (making posting on social media a faster process and an easier to "use" one) (a bit similar) Taken from a platform called Get My Farm Online, n.d. - Also because of the overall problems that farmers encounter when using social media *"Categories of farm-related information" section in literature review* - Glaves (2017), SocialB (2015), Hardesty (2011), Allen et al. (2012), Vassiliadou et al. (2011), Zhao and

			Zhang (2017), Tobey and Manore (2014), McConnel (2015), Prakash (2020), York (2009) + Facebook farming groups
Adding value to non-standardized products	Insert media	1. When selected, the system provides the user with the choice of adding an image to their post (i.e. insert picture button. 2. Tool suggests farmer if picture is suitable for the post based on the template/category/platform/ that will be shared on.	Barve, 2014; ElQadi, Dorin, Dyer, Burd, Bukovac and Shrestha, 2017; Facebook groups (e.g. Farming Technologies) + Kim & Dennis, 2018; Kim, Spiller & Hettche, 2015; Valerio, Herrera-Murillo, Villanueva-Puente, Herrera-Murillo, Del Carmen Rodriguez-Martinez, 2015 + Survey conducted on non-farmers
Maintain a regular posting schedule / remind farmers to post / make the process of sharing content on social media less time-consuming	Plan posts	The system will allow the user to keep track of his posts and make sure that he maintains a regular posting “habit”. 1. Calendar feature similar to “later.com”; it will autopublish the posts (i.e. the farmer can create the posts on Sunday and schedule them for the next week)	Leshed, Håkansson, and Kaye (2014); Naruka et al. (2017); - Interview with farmers: most of them complained they do not have enough time to use social media.

		2. Tool uses ratios and suggests farmer when is the right time to post on social media + sends a notification when time is close 3. Planning based on the social media platform used.	
Ensure high-quality content / ensure the content is correct and maintains a high standard	Information check	1. "Peer-review" process where the posts are being checked by authorized persons from the agriculture industry. 2. Post is sent to a platform similar to "factcheck.org" or "SciCheck". Farmer can select the option that his post should be checked by these platforms. 3. A like-based feature similar to ResearchGate: there will be a separate page in the app where scientists/farmers (maybe	*Misinformation section in lit. review* - Williams, 2019; Yonder, 2018; Chia-Nan, 2019; Miller, 2017; Chan, Kam, Coulthard, Pereira & Button, 2013; Rice, Hemsworth, Hemsworth & Coleman, 2020; - Interview with farmers: most of them complained about misinformation problems on social media

		that would have a required level based on their competencies /certificates) will see the posts and they will be able to wither like/dislike the post. - Like = post is ok; dislike = post is not ok.	
Ensure high-quality content / ensure the content is correct and maintains a high standard	Text analysis / check	1. Grammar check through available tools (i.e. grammarly, stars21.com) - When a farmer creates a post, the text is automatically analyzed through one of the available tools and suggestions for improvements are made 2. Provide a list of suggestions / most common grammar mistakes (e.g. “pe care” and “care”)	From Rianne’s thesis
Ensure the right audience is targeted / addressed	Choose social media platform to post	1. Farmer can select manually on which social	From the interviews with the farmers, one of them mentioned that a problem with

		media platform to share his content/post. 2. Tool suggests which platform is more suitable based on the location (i.e. in some countries some platforms are more popular than others). 3. Tool suggests which platform based on the template/category of information/type of media.	using social media is knowing which platform to choose to post your content on; “several social media platforms so it’s hard to choose one”, “which platform tells the right story”
	System requirements		
Inform users about actions that need to be performed	Notification sent (for farmers about the answers they receive) + if the post has been checked	The system will notify the user within 2 minutes when he receives an answer to his post.	
Inform users about actions that need to be performed	Notification sent for other users to share their post	The system will notify the users that it is the right time to share their post.	
Keep track more easily of all the farmer’s activity on social media	Visualization of all social media accounts statistics	1. The system uses the synced data from the user’s social media accounts and presents it in a user-friendly manner to the	- Similar to Social Blade (https://socialblade.com/)

		user. / a dashboard containing all info regarding the farmer's social media accounts (i.e. number of followers, posts) 2. Tool presents only statistics that have been made since the farmers used the tool.	
	Business requirements		
	Attract more customers	Through the scheduled (regular) posts and the templates used, the system will improve the relation between them and the consumers.	*"Felfies" trend / farm visits section in lit. review* - Vitto, 2014; Mess, 2014; SocialB, 2015; Hardesty, 2011; *Public relations and entrepreneurship section in lit. review* - Glaves, 2017; Allen, Abrams, Meyers, & Shultz, 2012; Vassiliadou, Vogiatzi, Amygdalas, & Mpoutakidis, 2011; York, 2009; Iwuchukwu, Eke and Nwobodo, 2019; Martono, Utama, Sulistiyanto and Christiyanto (2017);
	Adding value to non-standardized products	Through giving suggestions about whether posts should be added to their posts or not.	From interview with farmers: one famer mentioned that posts on social media containing pictures

			can be helpful for agricultural products that are non-standardized, such as a special breed of cows

Appendix C: Tasks Usability Testing

1. Share some information about the strawberries from your production on social media.
2. Post a picture with the strawberries.
3. Share your post on the most fitting platform.
4. Share your post on the 24th of March at 14:00.
5. Make sure that you provide reliable information that the users can trust.
6. Check if your post about cows was successful.
7. Find out if there has been a difference in the number of followers from your Twitter page.
8. Check to see if there is any information from your posts that you need to make changes to.
9. Look up your user account information.

Appendix D: Questions Interview Usability Testing

Q1. In general, what are your impressions of the application and why?
Q2. How would you describe the process of completing the previous tasks? Why?
Q3. What do you think can be improved regarding the application?
Q4. Was there something that you found confusing about the application? If yes, please describe.
Q5. Were there any difficulties in performing the tasks? If yes, please describe.

Appendix E: Translation Posts Created by Farmers

1. From today, you can find us in the small square in Arad. #Pipersgarden #authenticromanian
2. Next week we will be present at the market in the city, where we will sell the products with a 10% discount. Cherries, apples and apple juice are some of the products we will be waiting for you. See you there.

Appendix F: Questions Interview Farmers After Testing Session

a. In general, what are your impressions of the application and why?
b. How would you describe the process of creating a post using the tool compared to creating a post without it?
c. Which of the elements (i.e. template selection, media insertion, reminder) from the prototype do you consider to be helpful in the creation process? And why?
d. Which of the elements (i.e. template selection, media insertion, reminder) from the prototype do you consider to not be helpful in the creation process? And why?
e. Would you be interested in using this tool from now on?

Appendix G: Information Brochures and Consent Forms

Welcome to the 'Farmers and social media: a tool that assists farmers with posting social media content'. Before taking part in this study, please read the informed consent form below and click the "I Agree" button at the bottom of the page if you understand the statements and freely consent to participate in the study.

This study involves a web-based survey that examines whether non-farmers are interested in seeing farm-related content on the social media platforms that they use. Moreover, it will analyze which type of information coming from the farmers they find valuable or enjoyable. The survey takes 10 to 15 minutes to be filled in.

The study is being conducted by Daiana Iurescu under the supervision of Dr J.J. Li, as a master thesis project at the University of Twente. No deception is involved, and the study involves no more than minimal risk to participants (i.e., the level of risk encountered in daily life).

Your participation in this research study is voluntary. You may choose not to participate. If you decide to participate in this research survey, you may withdraw at any time. If you decide not to participate in this study or if you withdraw from participating at any time, you will not be penalized.

Your responses will be treated confidentially and anonymously. All data will be stored in a password protected electronic format. To help protect your confidentiality, the surveys will not contain information that will personally identify you. The results of this research study may be presented at scientific or professional meetings or published in scientific journals.

If you have any questions about the research study, please contact Daiana Iurescu by sending an email at d.iurescu@student.utwente.nl or by phone at +40 760 110 344. This research has been reviewed according to the University of Twente procedures for research involving human participants.

ELECTRONIC CONSENT: Please select your choice below.

Clicking on the "agree" button below indicates that:

- **You have read the above information**
- **You voluntarily agree to participate**
- **You are at least 18 years of age**

If you do not wish to participate in the research study, please decline participation by clicking on the "disagree" button.

- **Agree**
- **Disagree**

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Information Brochure

Protocol Director: R.W. Van Delden
Protocol Title: Farmers and social media: a tool that assists farmers with posting social media content

DESCRIPTION: You are invited to participate in a research study on how users interact with an interface from a tool designed to help farmers with posting on social media. You will be given a laptop and a mouse and you will be asked to perform short tasks with the prototype while thinking-aloud. At the end of the session, a semi-structured interview will take place where you will be asked to answer a few questions regarding the interface.

TIME INVOLVEMENT: Your participation will take approximately 30 minutes.

RISK AND BENEFITS: There are no risks that may reasonably be expected to result from this research. No deception is involved, and the study involves no more than minimal risk to participants (i.e., the level of risk encountered in daily life). We cannot guarantee that you will receive benefits from this study.

REQUIREMENTS TO PARTICIPANTS: You must be 18 years or older to participate.

PARTICIPANT'S RIGHTS: If you have read this form and have decided to participate in this project, please understand your participation is voluntary and you have the right to withdraw your consent and discontinue participation at any time without giving any reasons and without penalty or loss of benefits to which you are otherwise entitled. The alternative is not to participate. You have the right to refuse to answer particular questions. You have the right to refuse afterwards (within 24 hours) to allow your data to be used for the research. The results of this research study may be presented at scientific or professional meetings or published in scientific journals. Your data will be treated anonymously. Your identity will not be made known in written material resulting from the study.

CONTACT INFORMATION:
Questions: If you have any questions, concerns or complaints about the research, its procedures, risks and benefits, contact the Protocol Director, Dr Ir. R.W. Van Delden, at +31534893925 or email r.w.vandelden@utwente.nl; address: University of Twente, Zilverling (building no. 11), room 2102, Enschede 7522 NH.

Independent Contact: If you are not satisfied with how this study is being conducted, or if you have any concerns, complaints, or general questions about the research or your rights as a participant, please contact Ethics Committee, Faculty of EEMCS, University of Twente, Tel: +31 (0)5 3489 2085, ethics-comm-ewi@utwente.nl.

Appointment Contact: If you need to change your appointment, please contact Daiana Iurescu, Tel: +40 760 110 344 or email d.iurescu@student.utwente.nl.

Consent form

I hereby declare that I have been informed in a manner which is clear to me about the nature and method of the research as described in the aforementioned information brochure 'Farmers and social media: a tool that assists farmers with posting social media content'. My questions have been answered to my satisfaction. I agree with my own free will to participate in this research. I reserve the right to withdraw this consent without the need to give any reason and I am aware that I may withdraw from the experiment at any time. If my research results are to be used in scientific publications or made public in any other manner, then they will be made completely anonymous. My personal data will not be disclosed to third parties without my express permission. If I request further information about the research, now or in the future, I may contact researcher D. Iurescu; d.iurescu@student.utwente.nl.; supervisor R.W. Van Delden; r.w.vandelden@utwente.nl.

If you have any complaints about this research, please direct them to the secretary of the Ethics Committee at the University of Twente, telephone: +31 (0)53 489 2085; email: ethics-comm-ewi@utwente.nl.

Signed in duplicate:

....

Name subject Signature

I have provided explanatory notes about the research. I declare myself willing to answer to the best of my ability any questions which may still arise about the research.

....

Name researcher Signature

UNIVERSITY
OF TWENTE.

Information Brochure

Protocol Director: R.W. Van Delden
Protocol Title: Farmers and social media: a tool that assists farmers with posting social media content

DESCRIPTION: You are invited to participate in a research study on how farmers use social media. A semi-structured interview will be conducted over the phone in which you will be asked to answer a series of questions related to your usage of social media.

TIME INVOLVEMENT: Your participation will take approximately 30 minutes.

RISK AND BENEFITS: There are no risks that may reasonably be expected to result from this research. No deception is involved, and the study involves no more than minimal risk to participants (i.e., the level of risk encountered in daily life). We cannot guarantee that you will receive benefits from this study.

REQUIREMENTS TO PARTICIPANTS: You must be 18 years or older to participate.

PARTICIPANT'S RIGHTS: If you have read this form and have decided to participate in this project, please understand your participation is voluntary and you have the right to withdraw your consent and discontinue participation at any time without giving any reasons and without penalty or loss of benefits to which you are otherwise entitled. The alternative is not to participate. You have the right to refuse to answer particular questions. You have the right to refuse afterwards (within 24 hours) to allow your data to be used for the research. The results of this research study may be presented at scientific or professional meetings or published in scientific journals. Your data will be treated anonymously. Your identity will not be made known in written material resulting from the study.

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Independent Contact: If you are not satisfied with how this study is being conducted, or if you have any concerns, complaints, or general questions about the research or your rights as a

participant, please contact Ethics Committee, Faculty of EEMCS, University of Twente, Tel: +31 (0)5 3489 2085, ethics-comm-ewi@utwente.nl.

Appointment Contact: If you need to change your appointment, please contact Daiana Iurescu, Tel: +40 760 110 344 or email d.iurescu@student.utwente.nl.

Consent form

I hereby declare that I have been informed in a manner which is clear to me about the nature and method of the research as described in the aforementioned information brochure 'Farmers and social media: a tool that assists farmers with posting social media content'. My questions have been answered to my satisfaction. I agree with my own free will to participate in this research. I reserve the right to withdraw this consent without the need to give any reason and I am aware that I may withdraw from the experiment at any time. If my research results are to be used in scientific publications or made public in any other manner, then they will be made completely anonymous. My personal data will not be disclosed to third parties without my express permission. If I request further information about the research, now or in the future, I may contact researcher D. Iurescu; d.iurescu@student.utwente.nl; supervisor R.W. Van Delden; r.w.vandelden@utwente.nl.

If you have any complaints about this research, please direct them to the secretary of the Ethics Committee at the University of Twente, telephone: +31 (0)53 489 2085; email: ethics-comm-ewi@utwente.nl.

Signed in duplicate:

....

Name subject Signature

I have provided explanatory notes about the research. I declare myself willing to answer to the best of my ability any questions which may still arise about the research.

....

Name researcher Signature

UNIVERSITY
OF TWENTE.

Information Brochure

Protocol Director: R.W. Van Delden
Protocol Title: Farmers and social media: a tool that assists farmers with posting social media content

DESCRIPTION: You are invited to participate in a research study on how farmers interact with a tool designed to help them with posting on social media. You will be asked to install a mobile application and use it to create posts over the course of 1 week. You will create 2 posts without the application and 2 posts with the application. You will not have to share the posts on your social media accounts. The posts created will be used in a survey to see how non-farmers perceive those posts. At the end of the testing, you will be asked to answer a few questions about your experience using the application.

TIME INVOLVEMENT: Your participation will take place over the course of approximately 2 weeks.

RISK AND BENEFITS: There are no risks that may reasonably be expected to result from this research. No deception is involved, and the study involves no more than minimal risk to participants (i.e., the level of risk encountered in daily life). We cannot guarantee that you will receive benefits from this study.

REQUIREMENTS TO PARTICIPANTS: You must be a farmer and 18 years or older to participate.

PARTICIPANT'S RIGHTS: If you have read this form and have decided to participate in this project, please understand your participation is voluntary and you have the right to withdraw your consent and discontinue participation at any time without giving any reasons and without penalty or loss of benefits to which you are otherwise entitled. The alternative is not to participate. You have the right to refuse to answer particular questions. You have the right to refuse afterwards (within 24 hours) to allow your data to be used for the research. The results of this research study may be presented at scientific or professional meetings or published in scientific journals. Your data will be treated anonymously. Your identity will not be made known in written material resulting from the study.

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Appointment Contact: If you need to change your appointment, please contact Daiana Iurescu, Tel: +40 760 110 344 or email d.iurescu@student.utwente.nl.

Consent form

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If you have any complaints about this research, please direct them to the secretary of the Ethics Committee at the University of Twente, telephone: +31 (0)53 489 2085; email: ethics-comm-ewi@utwente.nl.

Signed in duplicate:

....

Name subject Signature

I have provided explanatory notes about the research. I declare myself willing to answer to the best of my ability any questions which may still arise about the research.

....

Name researcher Signature

Appendix H: Second Survey Averaged Values

Averaged values no tool condition	Averaged values tool condition
2.77	2.90
2.20	2.08
4.80	4.90
4.15	4.05
3.23	2.97
3.58	3.73
3.65	3.75
3.90	4.05
4.10	4.18
3.33	3.30
2.75	2.72
4.77	4.75
3.03	2.92
2.95	4.48
3.82	3.78
3.00	3.55
3.88	3.67
3.15	3.10
2.57	2.68
3.55	3.58
4.33	4.32
2.00	1.98
3.10	3.10
3.23	3.18
4.12	4.13
2.77	3.17
4.52	4.13
3.95	3.93
4.10	4.17
4.00	4.00

4.52	4.72
3.03	3.22
4.07	4.23
3.92	3.97
4.02	4.08
4.07	3.97
3.42	3.53
4.18	4.03
4.10	3.93
4.88	4.77
4.35	4.47
5.00	5.00
2.88	3.00
3.30	3.27
2.60	3.40
2.97	3.05
3.67	3.62
5.00	5.00
3.42	3.33
4.03	4.20
4.35	4.63
4.52	4.08
2.88	2.97
3.82	3.85
4.70	4.93
3.70	3.68
3.82	4.07
4.03	4.03
4.50	4.68
3.15	3.05
4.18	4.30
3.45	3.50
2.97	2.95

4.45	4.43
3.48	3.92
3.53	3.32
2.80	2.85
3.17	3.20
3.90	4.47
3.28	3.28
3.05	3.58
3.58	3.63
3.67	3.68
2.15	2.45
3.95	3.98
3.02	3.48
3.38	3.38

Appendix I: Templates With Translation

1. Amurg senzațional 🌄
   Final de zi cu activitate din plin. Sunetul naturii ne încântă și liniștește în același timp 🌤️

   EN: Sensational twilight 🌄
   End of the day with full activity. The sound of nature delights us and calms us at the same time 🌤️

2. Primele capsuni au plecat azi de la noi 🌤️🍓🍓🍓
   Capsunile au gustul exact cum ți l-ai imagina - "gustul copilăriei".

   EN: The first strawberries left from us today 🌤️🍓🍓🍓
   Strawberries taste exactly as you would imagine - "the taste of childhood".

3. Și pe ploaie avem ce recolta.
   Gustul copilăriei într-o singura ....

   EN: And in the rain we have something to harvest.
   The taste of childhood in one ....

4. Produsele noastre se pot livra gratuit in .... Cei care vor sa isi ridice singuri produsele, pot vizita gospodaria familiei noastre in ..., jud. ....

EN: Our products can be delivered free of charge in .... Those who want to pick up their products themselves, can visit our family's household in ..., county ....

5. Vand pasari crescute natural cu cereale si lucerna. Diferenta de greutate se datoreaza intocmai faptului ca nu au fost hranite cu hormoni de crestere, concentrat sau orice alti stimulenti. Datorita hranirii acestora cu furaje de calitate, gustul carnii este unul deosebit si traditional, incomparabil cu cel din supermarket-uri. Acestea sunt sacrificate in spatii adecvate din punct de vedere igienic avand si sanitar veterinar la comanda.

EN: I sell birds raised naturally with cereals and alfalfa. The difference in weight is due to the fact that they were not fed growth hormones, concentrate or any other stimulants. Due to their feeding with quality feed, the taste of the meat is special and traditional, incomparable with that of supermarkets. They are slaughtered in hygienically suitable spaces with veterinary sanitation to order.

6. Vand suc de rosii cu o compozitie de 100% rosii.
   Folosim rosii din gradina pe care le fierbem la foc de lemne pentru gust si aroma. Borcanele se fierb la bain-marie pentru conservare in timp. Nu se folosesc conservanti sau alti aditivi. Se poate folosi pentru orice tip de mancare (sau sosuri), dand un gust deosebit.
   EN: I am selling tomato juice with a composition of 100% tomatoes.
   We use tomatoes from the garden that we boil over a wood fire for taste and aroma. The jars are boiled in a bain-marie for preservation over time. No preservatives or other additives are used. It can be used for any type of food (or sauces), giving a special taste.

7. Saptamana viitoare vom fi prezenti la piata din oras, unde vom vinde produsele cu o reducere de ..%. …, ..., … sunt cateva din produsele cu care va vom astepta. Ne vedem acolo.

EN: Next week we will be present at the market in the city, where we will sell the products with a discount of ..%. …, ...,… are some of the products we will be waiting for you with. See you there.

8. Noua productie este gata si pregatita pentru dumneavoastra. Ve asteptam sa treceti pe la noi sa testati produsele proaspete.

EN: The new production is ready and prepared for you. We are waiting for you to stop by to try the fresh products.

9. Saptamana trecuta au venit in vizita la ferma mai multe familii cărora le-am prezentat modul in care crestem animalele/produsele si alaturi de care am organizat acitivitati ca sa inteleaga mai bine cum e o zi din viata unui fermier.

EN: Last week, several families came to visit the farm, to whom we presented the way we raise animals / products and with whom we organized activities to better understand what a day in a farmer's life is like.

10. Astăzi plantam … pentru a da un impuls de peste x saptamani diversității și captarii de energie prin fotosinteza.

EN: Today we plant… to give a boost of over x weeks to diversity and energy capture through photosynthesis.

11. (Animal 1) si (Animal 2) / (Planta 1) si (Planta 2) se bucura de soarele pe care ni-l oferă acest anotimp, in timp ce in spate putem vedea cum … O zi la fel de relaxanta va dorim si voua.

EN: (Animal 1) and (Animal 2) / (Plant 1) and (Plant 2) enjoy the sun that this season offers us, while in the back we can see how… An equally relaxing day we wish you and you.

12. Saptamana aceasta s-au făcut ... ani/luni de cand am deschis porțile fermei noastre. A fost o calatorie plina de succes dar și de eșecuri și este greu să-mi imaginez o meserie/cariera mai provocatoare si plina de satisfactii. Sunt tare curios sa vad ce surprize ne mai așteaptă de acum.
EN: This week has been ... years / months since we opened the gates of our farm. It was a journey full of success but also of failures and it is hard to imagine a more challenging and rewarding job / career. I am very curious to see what surprises await us from now on.

13. Ziua la ferma noastra a inceput la 7am cu livrarea noii combine. Este a 2-a combina pe care am cumparat-o în ultimii 5 ani deci putem spune ca nu e o zi tipică pentru noi. Sperăm sa reusim sa producem mai repede și mai eficient cu aceasta noua achizitie.

EN: The day at our farm started at 7am with the delivery of the new combine. It is the second combine we have bought in the last 5 years so we can say that it is not a typical day for us. We hope to be able to produce faster and more efficiently with this new acquisition.

14. Animalele/vitele/caii de la ferma noastra mananca o dieta bazata doar pe …. Pentru ca ne pasa de animalele și de clienții noștri, știm exact cu ce ne hranim animalele și de unde provine aceasta mancare.

EN: The animals / cattle / horses on our farm eat a diet based only on…. Because we care about our animals and our customers, we know exactly what we feed our animals and where this food comes from.

15. O alta incarcatura de animale/produse vegetale a plecat de dimineata spre clienti. In comparatie cu anul trecut, suntem cu numar de bani mai sus/mai jos ceea ce inseamna ca ….

EN: Another load of animals / vegetable products left for customers this morning. Compared to last year, we are with the number of money above / below which means that….

16. Saptamana trecuta, impreuna cu alti nr. fermieri, am semnat/pus la punct/stabilit o noua organizatie/un nou eveniment care isi doreste sa …. Speram sa fie de bun augur si sa ajute la dezvoltarea locala.

EN: Last week, together with others no. farmers, I signed / set up / established a new organization / a new event that wants to…. We hope it will be auspicious and help local development.

17. Peste număr de kg/tone de ingrasamant (alt produs) sunt pregatite pentru primavara și pentru noul sezon de plantat. Studiile/aplicațiile noastre proprii au arătat ca acest ingrasamant este mult mai benefic pentru culturile noastre cat si pentru mediul incojurator.

EN: Over the number of kg / ton of fertilizer (other product) are prepared for spring and the new planting season. Our own studies / applications have shown that this fertilizer is much more beneficial for our crops as well as for the environment.

18. Decât sa mancati substituenți/înlocuitori ai cărnii cu diferite produse precum soia, de ce sa nu aflați mai multe despre modul de producere a produselor non vegane? De ce sa nu cumparati produse sustenabile locale și să descoperiți cat de mult fermierilor le pasa de ceea ce mancati. #cumparalocalsisustenabil

EN: Instead of eating meat substitutes / substitutes with various products such as soy, why not learn more about how to produce non-vegan products? Why not buy local sustainable products and find out how much farmers care about what you eat. #buylocalandsustainable

19. Astăzi, împreuna cu familia, voi folosi tehnologia pentru o activititate agricola in timp ce ne bucurăm de peisaj și pasarelele zboara deasupra noastra si ne incanta auzul. Am cea mai frumoasă meserie din lume!

EN: Today, together with my family, I will use technology for an agricultural activity while we enjoy the scenery and the walkways fly over us and delight our hearing. I have the most beautiful job in the world!

20. Citatul zilei de la ferma noastra. Dupa incheierea turului fermei, unul dintre participanti ne-a declarat: …. Momentele acestea ne dovedesc ca ceea ce facem este pe masura.

EN: Quote of the day from our farm. After the tour of the farm, one of the participants told us:…. These moments prove to us that what we do is appropriate.

21. Contrar spuselor veganilor, carnea produsa la ferma noastra provine de la animale crescute prin cele mai naturale si sustenabile metode. Sunt sigur/a ca oricine vine in vizita la ferma noastra va fi de acord cu ceea ce spun dupa ce vede animalele.

EN: Contrary to what vegans say, the meat produced on our farm comes from animals raised by the most natural and sustainable methods. I am sure that anyone who comes to visit our farm will agree with what I say after seeing the animals.

22. Aceasta capcana pentru frunze si sedimente este doar una dintre utilitatile care infrumuseteaza peisajul nostru de la ferma. Cu siguranta avem nevoie de mai multe!

EN: This leaf and sediment trap is just one of the utilities that beautify our farm landscape. We definitely need more!

23. Se pare ca am avut norocul sa beneficiez de bunatatea unor oameni care s-au decis sa ….. la ferma noastra.

EN: It seems that I was lucky to benefit from the kindness of some people who decided to… at our farm.

24. Unii dintre noi vad frumusetea intr-un teren gata arat/prelucrat/alt cuvant, in timp ce altii (mai nebuni) asa ca mine o vad in pluglul/alta masina pus in functiune/la treaba. Poate ca e bine totusi ca vedem lucrurile diferit, nu?

EN: Some of us see beauty in a land ready to be plowed / processed / in other words, while others (crazier) so I see it in the plow / another car put into operation / at work. Maybe it's good that we see things differently, isn't it?

25. Element 1, element 2, element 3… - doar cateva din metodele prin care incercam sa avem grija si sa imbunatatim mediul inconjurator. #WorldEnvironmentDay

EN: Element 1, element 2, element 3… - just some of the methods through which we try to take care of and improve the environment. #WorldEnvironmentDay

26. Desi nu au fost replicate procedee stiintifice standardizate, totusi putem vedea diferenta intre cultura pe care am folosit …. si cultura pe care am folosit …. Cred ca putem trage singuri concluziile in aceasta situatie.

EN: Although no standardized scientific procedures have been replicated, we can still see the difference between the culture we used…. and the culture I used…. I think we can draw our own conclusions in this situation.

27. Proiectele primăverii 2021: achiziționarea unui nou …, extinderea tarcului de animale… Va urma o perioada foarte productiva. Tineti-ne pumnii.

EN: Spring 2021 projects: purchasing a new one…, expanding the animal enclosure… A very productive period will follow. Hold our fists.

28. Sa-i spunem bun venit lui ..., al doilea pui de ... venit pe lume in acest sezon/anotimp.

EN: Let's say welcome to ..., the second baby of ... born this season / season.

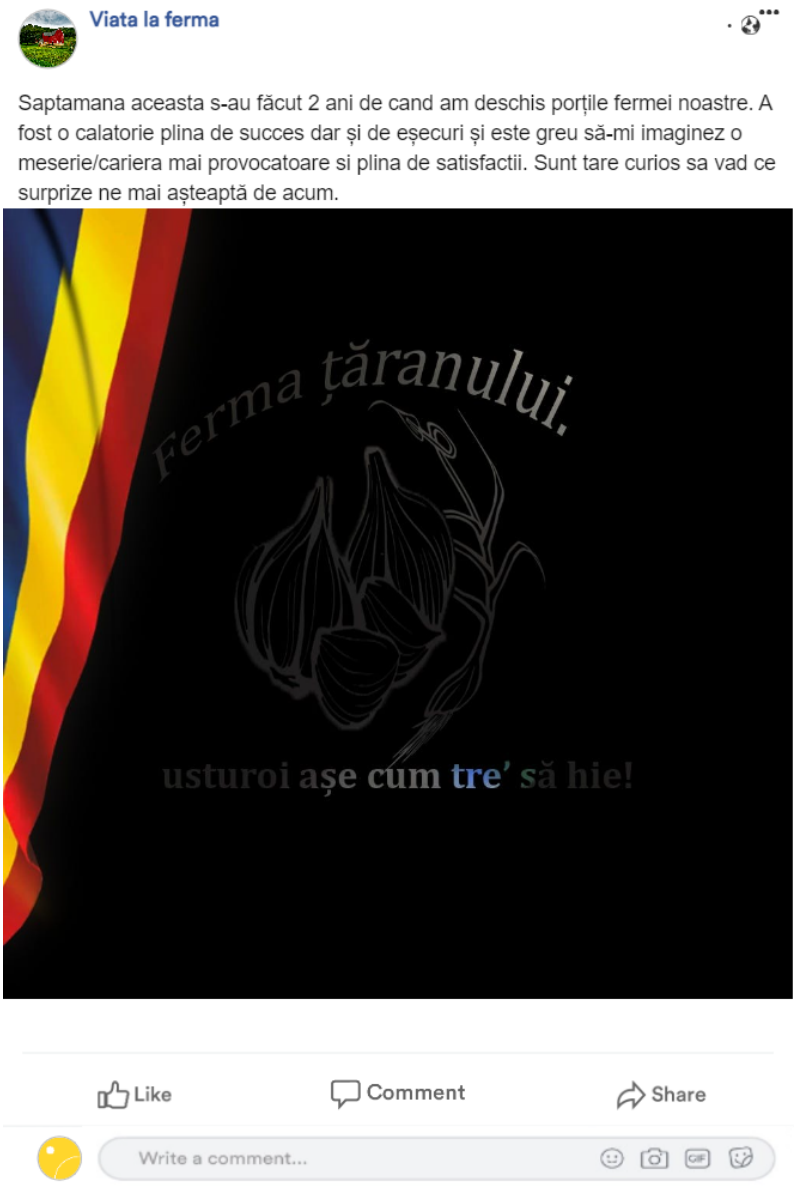
Appendix J: Posts With Translation

Posts created with the tool.

1. EN: The joy of the agricultural culture sown in the first days of sunrise.

2. EN: Sensational twilight 🌄
   End of the day with full activity.
   The sound of nature delights us and calms us at the same time 🌤️

3. EN: This week marks 2 years since we opened the gates of our farm. It was a journey full of success but also of failures and it is hard to imagine a more challenging and rewarding job / career. I am very curious to see what surprises await us from now on.

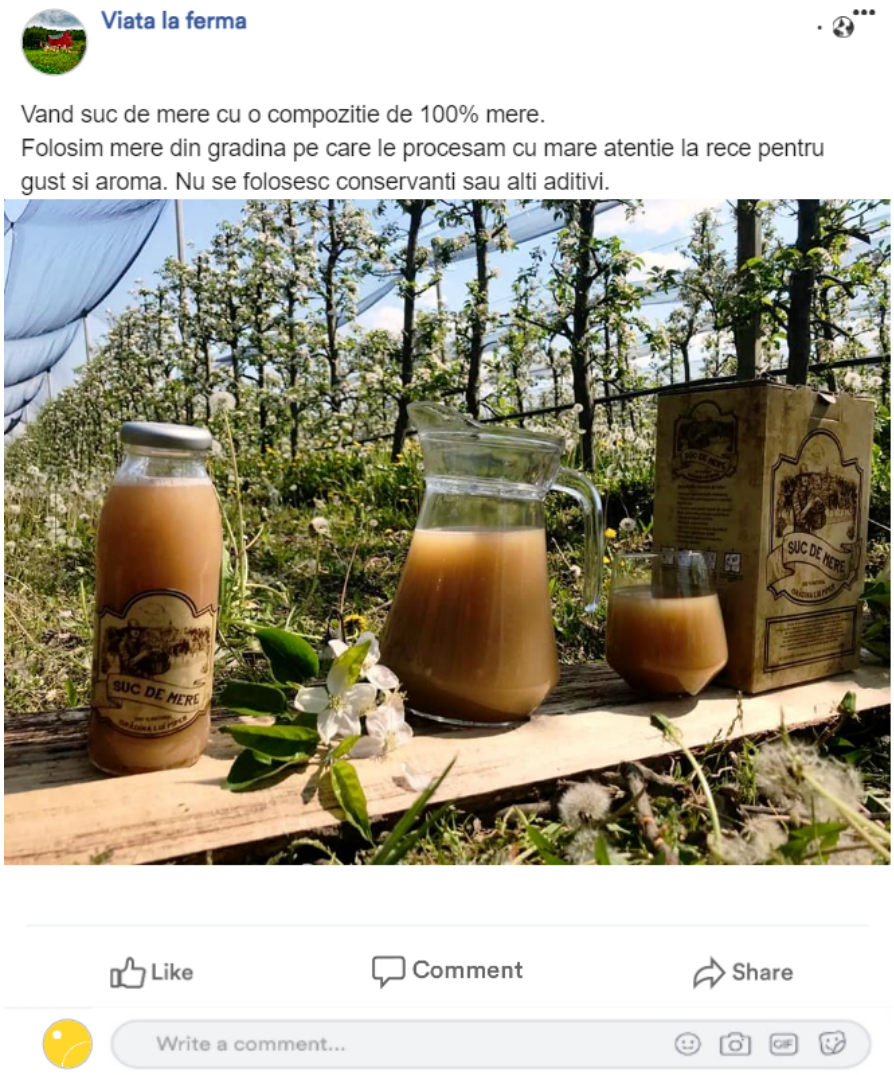


4. EN: Our products can be delivered free of charge in Sălaj County. Those who want to pick up their products themselves, can visit our family's household in Chiesd Commune Jud Salaj.

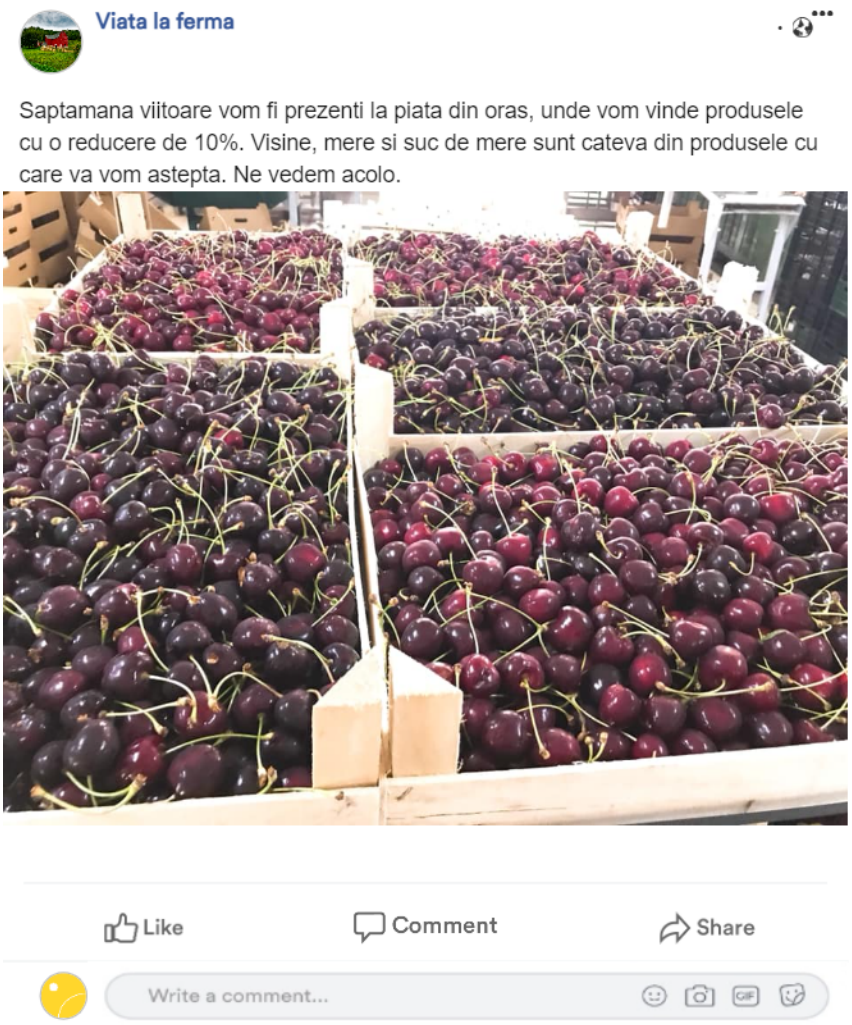
5. EN: And in the rain we have something to harvest. The taste of childhood in a single grain.

6. EN: At the end of the day I can say that I want to take a shower and eat 🤭 But this is the life of a farmer, sometimes you have the impression that you are getting wild, but you also have positive parts: best view, peace, etc.

7. EN: I am selling apple juice with 100% apple composition.
   We use apples from the garden, which we process very carefully in the cold for taste and aroma. No preservatives or other additives are used.



8. EN: Next week we will be present at the market in the city, where we will sell the products with a 10% discount. Cherries, apples and apple juice are some of the products we will be waiting for you. See you there.



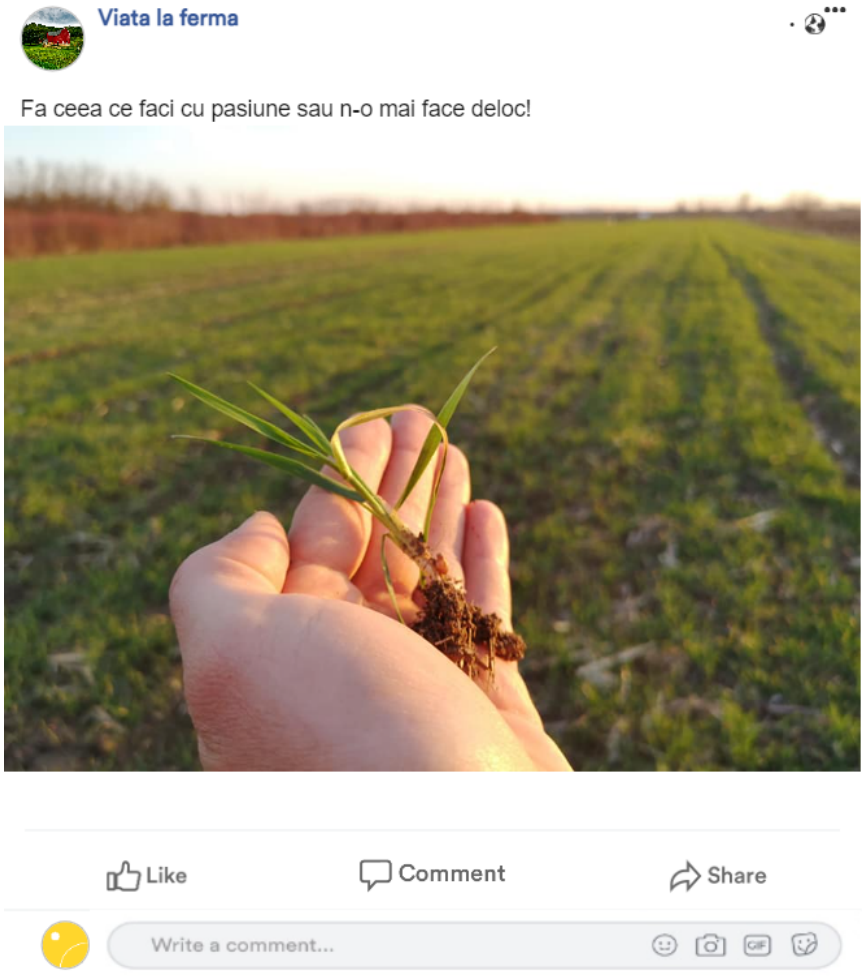
9. EN: Last week, several families came to visit the farm, to whom we presented the way we raise animals / products and others from which we organized activities to better understand what a day in a farmer's life is like.

10. EN: Although no standardized scientific procedures have been replicated, we can still see differences between crops that use only organic products and crops that use synthetic products. I think we can draw our own conclusions in this situation.

Posts created without the tool.

11. EN: Our everyday bread 🌾🌾🌾

12. EN: Do what you do with passion or don't do it at all!



13. EN: Dear Sălaj and not only,
    From now on we can communicate online not only face to face. We invite you with great pleasure and we welcome you with open arms to try with confidence the garlic from "Chieșd" cultivated out of passion for you. 🧄🧄
    "The trial has no death" 😁
    We wish you good health, peace of mind and may God help us in everything. 🙏

14. EN: Did you eat garlic? 😁 from afar, from overseas and country, but let's try ours from the farm.

15. EN: We start the week with a good mood and a lot of gratitude.
    Autumn barley Estoria!
    Thank you for being close to us! For details and orders please contact us at the phone number.

16. EN: After a tiring day, it's nice to see that your work pays off.

17. EN: From today, you can find us in the small square in Arad. #Pipersgarden #authenticromanian

18. EN: Proper vitaminization is essential in any season!
    The tasty fruits from our garden have been transformed into 💯 natural, nutritious and delicious juices!
    The juice is obtained through a cooling and cold pressing process, being packed in aseptic bags at 3l!

19. EN: We are slowly preparing for all of you who want to pamper us this summer, starting from July around July 15 we open the gates for those who want blackberries at 12 lei per kg, big sweet blackberries without thorns, we are waiting for you with children to come to us 😊😊

20. EN: Healthy blackberries 😕 this means respecting yourself and your customers, no questionable splashes. When you go green, that's the result, all around green.