The Importance of Digital Literacy Skills among Farmers for Sustainable Food Security

Wan Nor Haliza Wan Mokhtar, Tengku Adil Tengku Izhar, Muhamad Khairulnizam Zaini, Norhayati Hussin

The Importance of Digital Literacy Skills among Farmers for Sustainable Food Security

Wan Nor Haliza Wan Mokhtar, Tengku Adil Tengku Izhar, Muhamad Khairulnizam Zaini, Norhayati Hussin

Faculty of Information Management, Universiti Teknologi MARA, Malaysia
Email: whaliza@uitm.edu.my, tengkuadil4540@uitm.edu.my, nizam0374@uitm.edu.my, yatihussin@uitm.edu.my

Abstract
Food security has been recognized as one of the important elements to be considered in our daily lives. Farmers as the 'front liners' in producing the food and dealing with the natural resources need to be fed with good techniques and information needed to ensure their productions become more systematic each day. This is important to ensure that the farmers get to know the latest information and technology to breed their plants and crops progressively. Everyone needs to have practical skills in using technology to access, manage, manipulate and create information in an ethical and sustainable way. It is a continual learning process because of constant new applications and updates are conducted from time to time. The current trend which are using the digital platforms in delivering information to the society makes everyone realize that the basic information skills are very much needed to be obtained. Same goes to the digital agricultural information that would be used by the farmers all over the world. Some of the countries in the modern world have already employ the technology in enhancing their crop's plantations from small to a huge scale of trading. Basic digital literacy must be acquired by the farmers to materialize this effort. Then only the sustainability of the food security in various places can be extended globally. Each farmer has different skills and experience into adoption of smart agriculture technologies. They need to be trained and educate towards the latest basic technology. For that, the sustainable food security can be accomplished. The study is planned to be conducted quantitatively, where a set of questionnaire will be distributed to the target respondents. The results of the study are crucial for the policy makers in planning the strategies of delivering related information and to educate the farmers to become the digital literate society. Therefore, the smart farming practices can be implemented and enhance from time to time.
Keyword: Farmers Digital Literacy, Digital Literacy Skills, Food Security

Introduction
Based on recent studies, food security has been recognized as one of the important elements to be considered in our daily lives. The 2030 Agenda for Sustainable Development sets advancing a transformational vision identifying that our world is shifting, carrying with it new

challenges that must be solved if we want to live in a world without hunger, food insecurity and malnutrition in any of its forms. As mentions by the Food and Agricultural Organization of the United Nations (2019), the world population has developed progressively, with many people now living in urban areas. Technology has progressed at a worrying pace, whereas the economy has developed gradually interconnected and globalized. Nevertheless, many countries have not seen sustained evolution as part of this new economy. The world economy as a total is not rising as much as expected. Conflict and insecurity have increased and become more intractable, stimulating greater population displacement. Climate change and increasing climate inconsistency and extremes are distressing agricultural productivity, food production and natural resources, with influences on food systems and rural livelihoods, including a decline in the number of farmers. All of this has led to major changes in the way in which food is produced, circulated and consumed worldwide – and to new food security, nutrition and health challenges.

Therefore, it is very important to the food production and the natural resources to be seriously taken care in ensuring that the food security mitigation will not burden the society. For that reason, the farmers as the 'frontliners' in producing the food and dealing with the natural resources need to be fed with good techniques and information needed to ensure their productions become more progressing each day.

Literacy
According to Heick (2013), literacy is considered as the capability to make sense of something, regularly generalized as the capacity to read and write. In many means, reading is reading, media is media, but in the same method a composition dwellings unique intellectual capacity strains on a reader associated to a poem or a letter, so do digital media equated to classic media forms. In the 21st century, new literacies are evolving and digital media forms permit communication to be more advanced than ever before.

Digital Literacy
According to American Library Association (2020) digital literacy is like information literacy which involves skills and critical thinking in discovering and consuming information. Nevertheless, digital literacy consists of knowing digital tools and using them in communicative, collaborative ways through social engagement. The ALA's Digital Literacy Task Force describes digital literacy as "the ability to use information and communication technologies to find, evaluate, create, and communicate information, requiring both cognitive and technical skills."

Even though the connotation of digital literacy can momentously differ by source, even to the point of misperception, digital literacy comprehends 21st-century skills associated to the operative and suitable use of technology (Renaissance, 2020). Therefore, with the American Library Association digital literacy definition as a reference, it is significant to recognize that even digital nations who familiar with sending off text and post on social media are not considered "digitally literate" by any means in education. However, it might be sufficient to consider the farmers as digital literate community if they have the knowledge on seeking for information digitally.

Chan et al (2017) mentions that, digital literacy changes from time to time. Lankshear and Knobel (2008) describes digital literacy as the ability to read, write, view, listen, compose and communicate information. While Calvani et al (2008) highlight that digital literacy can be considered as an umbrella framework of skills, knowledge and ethics. On the other hand,

Martin (2008) defines a digital literate person as someone with the skill to identify, access, manage, integrate, evaluate, analyse and synthesize digital resources. He added that, digital literacy can be regarded by three levels. He believed digital literacy could be divided into three aspects consist of digital competence, digital usage and digital transformation. A few authors highlight digital literacy as a cognitive and socio-emotional phases while others emphasize it on the technical skills (Eshet-Alkalai, 2004).

While, Western Sydney University (2020), explains digital literacy as partaking the skills one needs to live, learn, and work in a society where communication and access to information is progressively over digital technologies like internet platforms, social media, and mobile devices.

Heick (2013) informs that digital literacy is related to the ability to make sense of digital media. This happens through expressive and supportable intake and curation patterns that increase an individual's prospective to add to a genuine community. In ensuring this to happen, the community should have the capability to analyse, prioritize, and act upon the immeasurable digital media 21st century nations encounter on a daily basis. According to Heick, digital literacy can be divided into four (4) principles namely:

1. Comprehension
The first principle of digital literacy is simply comprehension – the ability to extract implicit and explicit ideas from a media.

2. Interdependence
The second principle of digital literacy is interdependence – how one media form connects with another, whether potentially, metaphorically, ideally, or literally. Little media is created with the purpose of isolation, and publishing is easier than ever before. Due to the sheer abundance of media, it is necessary that media forms not simply co-exist, but supplement one another.

3. Social Factors
Sharing is no longer just a method of personal identity or distribution, but rather can create messages of its own. Who shares what to whom through what channels can not only determine the long-term success of the media, but can create organic ecosystems of sourcing, sharing, storing, and ultimately repackaging media.

4. Curation
Speaking of storing, overt storage of favored content through platforms such as pinterest, pearltrees, pocket and others is one method of "save to read later." But more subtly, when a video is collected in a YouTube channel, a poem ends up in a blog post, or an infographic is pinned to pinterest or stored on a learnist board, that is also a kind of literacy as well – the ability to understand the value of information, and keep it in a way that makes it accessible and useful long-term.

Elegant curation should resist data overload and other signs of "digital hoarding," while also providing the potential for social curation – working together to find, collect, and organize great information.

Digital Literacy Skills

According to Western Sydney University (2021) digital literacy means having the skills you need to live, learn, and work in a society where communication and access to information is increasingly through digital technologies like internet platforms, social media, and mobile devices. The Western Sydney University describes that developing ones' critical thinking skills is essential when they are confronted with so much information in different formats such as in searching, sifting, evaluating, applying and producing information that require them to think critically. Besides that, communication is also a key aspect of digital literacy. When communicating in virtual environments, the ability to clearly express the ideas, ask relevant questions, maintain respect, and build trust is just as important as when communicating in person. Everyone needs to have practical skills in using technology to access, manage, manipulate and create information in an ethical and sustainable way. It is a continual learning process because of constant new applications and updates are conducted from time to time. Therefore, everyone will be very grateful if they update themselves with related skills that could help them in organizing their daily needs and tasks effectively.

Previously, Meyer, Erickson, and Small, (2013) inform that the new technologies and developments in media are changing the way that individuals, groups and societies communicate, learn, work and govern. This new socio-technical era necessitates participants to have not only skills and abilities associated to the use of technological tools, but also knowledge concerning the standards and practices of suitable tradition. They added that to be 'digitally literate' in this way involves issues of cognitive authority, safety and privacy, creative, ethical, and responsible use and reuse of digital media, among other topics. A lack of digital literacy progressively incriminates one's full potential of being a proficient student, an authorized employee or an engaged citizen. Digital literacy is frequently measured as a school-based proficiency, but it is presented and established in informal learning settings such as libraries, museums, social groups, similar spaces online, not to mention the home environment.

Gilster (1997) mentions in the late 1990's, 'digital literacy' can be defined as recognizing the fundamental but revolutionary uniqueness of the internet and identifying the digitally literate students by having specific set of information skills such as information searching and information evaluation that applied to text and multimedia information retrieved on the internet which are in a formal, school-based learning context. He added that even in its initial conceptualization, it was understood that being digitally literate far bettered the basic literacy skills of reading, writing, listening and speaking. Furthermore, Meyer, Erickson, and Small, (2013) highlight that with current digital media and technologies, everyone can as well create, work, share, socialize, research, play, collaborate, communicate and learn. On the other hand, Chase and Laufenberg (2011) say digital literacy can be called 'inherently squishy'. They added that descriptions of the term now array from merely being technology fluent to the capability to put on information literacy skills (e.g., locating, extracting, organizing, managing, presenting and evaluating information) in digital settings to broader, more complex conceptual frameworks that comprehend a wide variety of skills, understandings, norms and practices can be implemented.

Farmers Digital Literacy

It is undeniable that digital literacy is really important nowadays, no matter you are a university student, an officer at the organization as well as the farmers in this modern world. The current trend which are using the digital platforms in delivering information to the society

makes everyone realize that the basic information skills are very much needed to be obtained. It is said that it will also be really important in the future when everyone enters the more sophisticated world. In the workplace ones would be required to interact with people in digital environments, use information in appropriate ways, and create new ideas and products collaboratively. Above all, everyone needs to maintain their digital identity and wellbeing as the digital landscape continues to change at a fast pace. Same goes to the digital agricultural information that would be used by the farmers all over the world. In fact, some of the countries in the modern world have already employ the technology in enhancing their crop's plantations from small to a huge scale of trading.

According to Soylu et al (2016), information retrieved by the farmers basically related to their needs in agricultural information. The information they look for in their work-related will enable the day-to-day organization of their work and certain digital information from diverse resources are also progressively becoming accessible for their use. Singh & Satija (2006) highlight that information seeking behaviour and information of the users are the interlinked tools that create a circulation ration that target the various information user groups. They explain that sequences of attitudes in target focused on tenacity development is called information seeking behaviour. They added, farmers are one of the sub-groups consuming information to contribute to the establishment of a green world. Marchionini (1995) once says, the person who use information and accomplish it makes them progress as part of the globalization process in today's global and virtual world. It is undeniable that information is a useful 'instrument' in easing the life movement of individuals. This 'instrument' is used by individuals in order to solve complications, doubts and disordered situations in one's life for example in their daily task such as farmers and their daily chores.

Furthermore, Opara (2008) mentions that agricultural efficiency and crop can fundamentally be improved through information. He claims that, agricultural and rural development need not avoid information for the continuous improvement, same goes to the farmers. Adomi, Ogbomo, and Inoni (2003) highlight that, farmers need information if they want to be successful. In other words, farmers need other farmers' information and data, which is known as "indigenous information" to gain extra knowledge. They added that, when farmers face a comparable condition that their associate has already overcome, they may adapt and adopt their problem solving techniques. For example, in a research held in different rural areas of Philippines, it was discovered that most communal information source of farmers about new seed variations was from other farmers. Ramirez (1997) says that, agricultural experts lacked the essential support that they were thought to provide the farmers with. As what has been inform by Opara (2008) it is significant for them to acquire the appropriate, expressive, acquainted and trustworthy information in time for their effectiveness. Therefore, the importance of farmers' digital literacy cannot be denied as they should seek for the related information themselves from time to time for the overall sustainable food security.

Meitei and Devi (2009) discuss that it is essential to encounter the information needs of farmers for national development especially at the agriculture-based economy country. As stated by Padel (2001) the most collective sources for farmers to get associated and necessary information that they entail is from publications (magazines, books etc.), other farmers, family members and friends, public libraries with sufficient agricultural sources, stopovers to organic farms, possible appearance at seminars and regional meetings, as well as audio-visual sources for farmers with lower literacy level. Soylu et al (2016) inform that, there was a research conducted in Manipur, India on daily information need of farmers which was not met due to numerous explanations such as lack of infrastructure, limited manpower to spread

information in remote areas, lack of an agricultural information center and non-accessibility of appropriate information and communication network systems. Therefore, Meitei and Devi (2009) believe that a significant work and effort is mandatory for information support to continuous agricultural growth with the submission of evolving information and communication technologies in rural farming community.

Soylu et al (2016) highlight, the admittance to this kind of information is restricted due to low literacy level of farmers, the shortage of infrastructure in rural community and the insufficient number of addition officers who may distribute such information to farmers. Nevertheless, with the sole determination of providing hands-on resolutions for the farmers, their information need and information seeking behavior can be analyzed and addressed. They added that affording to the addressed need and information behavior, municipalities and farming associations can offer farmers with information that may be valuable in the daily-based work routine. They also mention that internet is in fact a substantial source of information for the farmers which delivers countless amenities for their advantage. This is when the farmers' digital literacy is very much needed since the information can easily be shared with the technology advancement besides adequate and sufficient equipment must be obtained by the farmers' community. For that, basic digital literacy must be acquired by the farmers to materialize this effort. Then only the sustainability of the food security in various places can be extended globally.

As stated by Suebsombut et al (2020), smart agriculture is a theory of management of modern farming using smart/digital techniques to monitor, to optimize, and to control progressions of agricultural production. To manage farm right now, the literacy in smart agricultural technologies is important so that farmers need to progress themselves to adopt smart technologies for farming. Nevertheless, each farmer has the difference skills and experience into adoption of smart agriculture technologies. They need to be trained and educate towards the latest basic technology.

Food Security
Clay (2002) informs that food security is a flexible theory as reflected in various attempts at definition in research and policy usage. Maxwell and Smith (1992) mention that even a decade ago, there were about 200 definitions in published writings discussing on food security. Every time the theory is presented in the title of a study or its objectives, it is essential to look closely to create the explicit or implied definition (Maxwell, 1996).
According to Clay (2002), the ongoing advancement of food security as an operational concept in public policy has returned the extensive appreciation of the complications of the technical and policy issues involved.
Food security as a concept initiated only in the mid-1970s, in the discussions of international food problems at a time of global food crisis. The preliminary effort of attention was predominantly on food supply problems - of promising the availability and to some degree the price steadiness of basic foodstuffs at the international and national level. That supply-side, international and institutional set of concerns replicated the changing organization of the global food economy that had triggered the crisis. A process of international cooperation followed, leading to the World Food Conference of 1974, and a new set of institutional engagements covering information, resources for promoting food security and forums for dialogue on policy issues (ODI, 1997).

Issues in Farmers' Digital Literacy / Information Needs

Reduction of Agriculture Workforce Engagement

Formally, agriculture, forestry, and fishing once formulate the source of the Malaysian economy. However, between 1970 and the early 21st century their impact to the country's gross domestic product (GDP) dropped from roughly one-third to less than one-tenth. Likewise, the percentage of the workforce engaged in agriculture declined from about one-half to less than one-eighth over the same duration, and the trend has continued (Bee and Zakaria, 2020). This probably occurred because of the lack of agricultural information obtained by the farmers in practicing good agricultural practices. For that, related study need to be conducted to overcome this problem.

The Importance of Information to Farmers

Nzonzo and Mogambi (2016) highlight that information is becoming a most important contribution in agriculture, whereas, knowledge and information plays a vital role for farmers to reply to opportunities that could increase their agricultural productivity.

Masuki et al (2010) mention that, agricultural information basically, is a key element in cultivating small-scale agricultural production and associating better production to remunerative markets, thus leading to improved rural livelihoods, food security and national economics. On the other hands, Mittal and Tripathi (2009) say information-based, decision making agricultural system (Precision Agriculture) is intended to maximize agricultural production and is frequently defined as the next great evolution in agriculture.

Setiawan et al (2020) mention that, the information has a vital role in supporting numerous activities of individuals because the information has turn into a substantial need of every person. The growth of science and technology in numerous arenas has improved the quantity of information created, which is packed in numerous forms and can be retrieved easily and quickly. Rufaidah (2013) says this has rooted an outburst of information and to attain that information entails information literacy capabilities. In this case, information literacy has very close relationship with information technology.

Farmers' Education

Nicholas-Ere (2017) informs that rural farmers refer to farmers who are living in the rural areas, where most of them have low level of education. Their main occupation is survival farming and they are commonly categorized by poverty, poor health condition and ignorance. Rural farmers in developing countries must access to information, especially in this digital age (Mbagwu et al., 2018).

Khan et al (2020) highlight that, the agriculture area in Pakistan faces huge challenges of lack of farm knowledge adoption because of the farmers' deficiency of admission to the newest information. They also discuss that in recent times numerous mobile phone-based farm advisory services (FAS) have been introduced as a substitute to the conservative extension approaches. Regardless of many ICT initiatives, the presentation of these developments remains insufficient. The recent research was conducted to identify these FAS, farmers' extent of use, and factors associated with their adoption. The results determine that education and digital literacy are necessary for the use of mobile-based alternatives and highlight the need for training and educating the farmers.

Information Technology Era

Priatni and Pradita (2015); Laranti (2017) inform that some aspects that stimulate the use of new media by farmers are information quality, system quality, and users' convenience. They also highlight that it is necessary to have media literacy, and information literacy regarding the use of new media carried out by various parties. Setiawan, Putri, Yanti, Widhiasthinid, and Kurniawane (2020) mention that new media increases the quantity of information by a great volume. However, the advent of this innovative approach has not been supplemented by the excellence of human resources that prioritises cultural values and social values of the community. They added that information technology allows a person to retrieve information using media such as computers, application software, databases, and other technologies. American Library Association (2000) earlier describe, new approach of information technology has increase the volume of information by a great amount.

Agriculture Information Needs

Madhavan (2017) mentions that in farm management, the resolutions are directed by information. Farmers are consequently involved in information search, in order to fill the information gap and to fulfil their goals. Keeping this in mind, an attempt is made here to recognize farmers' viewpoint about agricultural information needs in general. Agricultural information refers to all published and unpublished knowledge, on general aspects of agriculture and consists of innovations, ideas and technological practices. Such information needs consist of information on recommended practices, soil conservation, prevention of plants and animal disease, fertiliser application, farm machineries, proper storage of farm products, marketing techniques etc. Therefore, the whole agricultural information needs of the farmers are identified and presented, followed by the analysis of the awareness, access and gap, in each of this agricultural information identified.

Conclusion

It is undeniable that information can be considered as a fundamental element used by everyone in this modern society. People require different type of information to sustain with the contemporary growths and follow universal developments in this changing world. Information can be pick up as an instrument required by different users. According to Soylu et al (2016), characteristic of information needed by users can be identified according to the type of need required by certain groups. Farmers community have an ability and influence to control their surroundings. They need and share information related to many areas on finance, market, technology and in other relevant fields. They added that the information interchange process is a crucial part of a farming system. It is essential for the farmers to understand communication networks, ecological condition and changes in the market place in order to comprehend a farming system where there are lots of sources of invention and advancement. Therefore, various sources are needed in terms of fulfilling the information needs of farmers and mass media is worthy in making them responsive of innovations discovered (Opara, 2008). That is why digital literacy skills among farmers are essential in sustaining food security globally.

References

Adomi, E. E., Ogbomo, M. O., and Inoni, M. O. (2003), Gender factor in crop farmers' access to agricultural information in rural areas of Delta State, Nigeria, Library Review, Vol. 52 Iss 8 pp. 388 – 393.

American Library Association (2020). Digital Literacy. Retrieved from https://literacy.ala.org/digital-literacy/

Bee, O. L., & Ahmad, Z. (2020). Malaysia. Encyclopædia Britannica. Encyclopædia Britannica, inc. Retrieved on 17th August 2020 from https://www.britannica.com/place/Malaysia

Calvani, A., Cartelli, A., Fini, A., & Ranieri, M. (2008). Models and instruments for assessing digital competence at school.Journal of e-Learning and Knowledge Society, 4(3), 183-193.

Chan, B. S. K., Churchill, D., & Chiu, T. K. F. (2017). Digital Literacy Learning In Higher Education Through Digital Storytelling Approach. Journal of International Education Research (JIER), 13(1), 1-16. https://doi.org/10.19030/jier.v13i1.9907

Chase, Z., & Laufenberg, D. (2011). "Embracing the Squishiness of Digital Literacy." Journal of Adolescent & Adult Literacy, 54 (7): 535–537. doi: 10.1598/JAAL.54.7.7

Clay, E. (2002). Overseas Development Institute, London, UK, for the FAO Expert Consultation on Trade and Food Security: Conceptualizing the Linkages, Rome, 11-12 July 2002. http://www.fao.org/3/y4671e/y4671e06.htm

Eshet-Alkalai, Y. (2004). Digital Literacy: A Conceptual Framework for Survival Skills in the Digital Era. Journal of Educational Multimedia and Hypermedia, 13(1), 93.

Food and Agriculture Organization of the United Nations (Rome, 2019). The State of Food Security and Nutrition in the World: Safeguarding Against Economic Slowdowns and Downturns. Retrieved from https://www.who.int/nutrition/publications/foodsecurity/state-food-security-nutrition-2019-en.pdf?ua=1

Gilster, P. (1997). Digital Literacy, New York: John Wiley.

Heick, T. (2013). Four (4) Principles of Digital Literacy. Retrieved from https://www.teachthought.com/literacy/4-principals-of-digital-literacy/

Lankshear, C., & Knobel, M. (2008). Digital literacies: concepts, policies and practices: New York: Peter Lang.

Laranti. (2017). Paradita, 2015, Opportunities for utilization of new media in increasing literacy in agricultural HR information, https://bit.ly/2TgC38S

Madhavan, S. (2017). Agriculture information needs of farmers: An overview. International Journal of Agricultural Science and Research (IJASR)ISSN (P): 2250-0057; ISSN (E): 2321-0087Vol. 7, Issue 6, Dec 2017, 209-216

Marchionini, Gary. (1996). Information Seeking in Electronic Environment. 10.2307/40324289.

Martin, A. (2008). Digital Literacy and the "Digital Society". In C. Lankshear & M. Knobel (Eds.), Digital Literacies: Concepts, Policies and Practices(pp. 151-176). New York: Peter Lang.

Masuki. F. G., Kamugisha, R., Mowo, J. G, Tanui, J., Tukahirwa, J., Mogoi, J., & Adera, E. O. (2010). Role of mobile phones in improving communication and information delivery for agricultural development: lesson from south western Uganda. ICT and Development Research Voices for Africa. International Federal for Information Processing (IFIP), Technical Commission 9 – Relationship between Computers and Society Workshop at Makere University, Uganda 22-23 March.

Maxwell, S. (1996). Food security: a post-modern perspective. Food Policy. 21 (2): 155-170.

Maxwell, S., & Smith, M. (1992). Household food security; a conceptual review. In S. Maxwell & T.R. Frankenberger, eds. Household Food Security: Concepts, Indicators, Measurements: A Technical Review. New York and Rome: UNICEF and IFAD.

Mbagwu, F. C., Benson, O. V., and Charis O. Onuoha, C. O. (2018). Challenges of meeting information needs of rural farmers through internet-based services: experiences from developing countries in Africa. The World Library and Information Congress: 84th International Federation Of Library Association (IFLA) Conferenceat: Malaysia, p. 1 – 9. http://library.ifla.org/2195/1/166-mbagwu-en.pdf

Meitei, L. S., & Devi, T. P. (2009). Farmers information needs in rural Manipur: an assessment. Anaals of Library and Information Studies. Vol. 56. pp.35-40.

Meyer, E. M., Erickson, I., and Small, R. V. (2013). Digital literacy and informal learning environments: an introduction, Learning, Media and Technology, 38:4, 355-367, DOI: 10.1080/17439884.2013.783597

Mittal, S. & Tripathi, G. (2009). Role of mobile phone technology in improving small farm productivity. Agricultural Economics Research Review, 22, 451-459.

Nicholase-Ere, O. (2017). Dissemination of agricultural information to farmers using ICT. International Journal of Computer Applications, 179 (7), 27 – 31.

Nzonzo, D., & Moganmbi, H. (2016). An analysis of communication and information communication technologies adoption in irrigated rice production in Kenya. International. Journal of Education and Research, 4 (12), 295-316.

ODI. (1997). Global hunger and food security after the World Food Summit. ODI Briefing Paper 1997 (1) February. London: Overseas Development Institute.

Opara, U. N. (2008). Agricultural information sources used by farmers in Imo State, Nigeria. Information Development. Vol. 24, No. 4. pp. 289-295.

Padel, S. (2001). Conversion to organic milk production: The change process and farmers' information needs. (Unpublished doctoral thesis). University of Wales, Aberystwyth

Priatni, S., & Pradita, A. (2015). Stability study of betacyanin extract from red dragon fruit (Hylocereus Polyrhizus) peels. Procedia Chemistry. Vol. 16, pp. 438-444, ISSN 1876-6196, https://doi.org/10.1016/j.proche.2015.12.076.(https://www.sciencedirect.com/science/article/pii/S1876619615002247)

Ramirez, R. (1997). Gatekeeper 66: Understanding farmers' communication networks: Combining PRA with agricultural knowledge systems analysis. Accessed through pubs.iied.org/612OIIED.html

Renaissance. (2020). What is digital literacy and why does it matter? Retrieved from https://www.renaissance.com/2019/02/08/blog-digital-literacy-why-does-it-matter/#:~:text=The%20American%20Library%20Association%20(ALA,both%20cognitive%20and%20technical%20skills.%E2%80%9D

Rufaidah. (2013). Opportunities for utilization of new media in increasing literacy in agricultural HR information, [online], (https://bit.ly/2TgC38S

Setiawan, I. W. A., Putri, P. H., Yanti, K. O. C. D., Widhiasthinid, N. W., & Kurniawane, I. G. A. (2020). Literacy utilisation of information technology for farmers in Badung Regency, Bali, in the era of industrial revolution 4.0. International Journal of Innovation, Creativity and Change. www.ijicc.net Volume 13, Issue 11, 2020 https://www.ijicc.net/images/vol_13/Iss_11/131154_Widhiasthini_2020_E_R.pdf

Singh, K. P., and Satija, M. P. (2006) A review of research on information seeking of agricultural scientists: International perspectives. DESIDOC Bulletin of Information Technology, 26(2):25-36

Soylu, D., Cevher, N., Schirone, M., Medeni, T. (2016). A comparative study of information-seeking behavior and digital information needs of farmers in turkey and sweden.

International Journal of eBusiness and eGovernment Studies, 8 (2), 18-33. Retrieved from https://dergipark.org.tr/en/pub/ijebeg/issue/26191/275814

Western Sydney University. (2020). What is digital literacy?. Retrieved from https://www.westernsydney.edu.au/studysmart/home/study_skills_guides/digital_literacy/what_is_digital_literacy

Western Sydney University. (2021). What is digital literacy? Retrieved on 5th March 2021 from
https://www.westernsydney.edu.au/studysmart/home/study_skills_guides/digital_literacy/what_is_digital_literacy#:~:text=Digital%20literacy%20means%20having%20the,social%20media%2C%20and%20mobile%20devices.