Dimensions of rural web as factors influencing farmer's adoption of sustainable agricultural practices: A review

N K Sulaiman*, S H Misnan, M F Rashid

Department of Urban and Regional Planning, Faculty of Built Environment and Surveying, Universiti Teknologi Malaysia (UTM), 81310 Johor, Malaysia

*Email: naziakhalida@gmail.com

Abstract. Agriculture is one of the main driving forces of rural development. Ensuring its sustainability in practice will provide economic, social and environmental benefits to the rural area. This will then contribute to sustainable rural development in general. Similarly, the processes of rural development are also the external influences that can facilitate the condition for sustainable practices to be carried out in ease of manner. The purpose of this paper is to analyse the importance of rural development processes as facilitating factors in farmer's decision-making on the adoption of Sustainable Agricultural Practices (SAP). Using the method of Protocol, Search, Appraisal, Synthesis, Analysis and Reporting (PSALSAR), this study has adapted six steps towards conducting a systematic literature review. A total of 50 empirical studies obtained from Scopus database were reviewed to determine the significant factors influencing the adoption of SAP. These factors were then coded into six dimensions of rural development processes which are endogeneity, novelty, market governance, institutional, social capital and sustainability. The finding of this paper has discovered that the institutional dimension contains the most factors influencing SAP adoption, followed up by social capital. The rural development dimension with the least significant factors from the empirical studies reviewed is the novelty dimension. This finding has highlighted the gap in the literature regarding factors influencing adoption. Future research should consider exploring the relationship between farmers' novelty practices with their decisions in adopting SAP.

1. Introduction

In many different countries, agriculture is the powerhouse of its economy. Natural resources have a significant role in accommodating agricultural production, and the unsustainable use of these resources will only create future negative impacts. Conventional agriculture has been linked to many environmental concerns and this creates the need for agriculture to be practised sustainably. Besides providing benefits to the conservation of the environment, sustainable agricultural practices (SAP) also significantly reduce household poverty [1]. Sustainably practising agriculture contributes to the well-being of the rural community, it's a means towards obtaining sustainable rural development. SAP is not a new concept, yet the rate of adoption all over the world has not been significantly satisfying.

The studies of farmers' behaviour on adoption have evolved since its initial findings in the 1980s [2]-[3]-[4] and the robust literature has provided a countless amount of framework in understanding farmer's adoption. The need to understand these influencing factors is crucial to encourage more adoption of sustainable measures. The novelty of this review paper lies in the integration of an idea that rural development processes also play an important role in providing the external conditions that influence farmer's adoption. The purpose of this paper is to analyze the importance of rural development processes as facilitating factors in farmer's decision-making on the adoption of SAP.

2. Adoption of sustainable agriculture in the context of rural development

Addressing the environmental problems of intensive agriculture is an important feature of rural development. It is essential to link agriculture production with conservation to plan for the rural areas. Sustainable rural development can be defined as the economic, social and cultural improvement that protects the environment while contributing to the well-being of the rural community [5]. The modernization of agriculture which has resulted in environmental degradation has created an increase of awareness on the importance of conserving natural resources [6]. This has provided the need for sustainable agriculture to be one of the main agendas for rural development.

According to the concept of rural web, sustainable rural development consists of six dimensions of processes. The dimensions are endogeneity, novelty, market governance, institutional, social capital and sustainability [7]. Rural web is a conceptual model that represents the idea that for sustainable rural development to occur, it has to be supported by these six dimensions as its supporting resources. From the perspective of SAP adoption, these six dimensions have the potential of acting as influencing factors. Agricultural practices that are considered sustainable are mostly tailored towards the condition of its farmland. Most SAPs that are commonly practised and easily executed by farmers are conservational practices such as conservation tillage, crop rotation, composting, crop diversification, and intercropping. The different types of SAPs covered in this review are listed out in Table 1 below.

3. Materials and methods

Using the PSALSAR method, this study has adapted six steps towards conducting a systematic literature review [8]. The six steps are protocol (define the research scope), search (define searching string and types of databases), appraisal (pre-defined literature inclusion and exclusion, and quality assessment criteria), synthesis (extract and categorized the data), and analysis (narrate the result and finally reach into conclusion), and reporting results (stating the procedure followed and communicating the result). The Scopus database was used to obtain the empirical studies for this review due to its large database of peer-reviewed literature. The screening process for the abstracts was performed using a tool called Abstrackr. Abstrackr is a system to facilitate screening for systematic reviews [9]. Once the papers were screened to fit the inclusion criteria, Google Scholar was then used as a secondary database to perform citation tracking.

Table 1. Overview of selected empirical papers on factors of SAP adoption.

Author(s)	Study Area	Sample Size	Type of SAP	Statistical Model Used
Abdulai et al. [10]	Zambia	408	Crop rotation, cover crops	Factor analytic model
Adnan et al. [11]	Malaysia	74	Green Fertilizer Technology	Structural equation model
Adusumilli and Wang [12]	Unites States	500	Best Management Practices	Probit model
Agholor and Nkosi [13]	South Africa	100	Water Conservation Practices	Logit model
Amare and Simane [14]	Ethiopia	442	Water and Soil Conservation Measures	Logit model
Arunrat et al. [15]	Thailand	661	Irrigation system, crop rotation	Logit model
Aryal et al. [16]	India	1267	Climate Smart Agriculture	Probit model

Badu-Gyan et al. [17]	Ghana	295	Organic farming	Logit model
Bavorová et al. [18]	Russia	110	Reduced tillage practices	Logit model
Branca and Perelli [19]	Ethiopia	2218	Climate Smart Agriculture	Fractional regression
Canales et al. [20]	United States	290	Soil Conservation Practices	Logit model
Debie [21]	Ethiopia	155	Compost and crop rotation	Logit model
Dhehibi et al. [22]	Tunisia	250	Water and Soil Conservation Measures	Logit model
Etsay et al. [23]	Ethiopia	230	Sustainable Land Management	Logit and probit model
Faridi et al. [24]	Iran	538	Water and Soil Conservation Measures	Structural equation model
Han et al. [25]	China	385	Conservation tillage	Logit model
Hou and Hou [26]	China	442	Low-carbon agriculture	Structural equation model
Jabbar et al. [27]	Pakistan	612	Sustainable Intensification Practices	Probit model
Jha et al. [28]	Tanzania	701	Water Conservation Practices	Logit model
Ji et al. [29]	China	266	Conservation tillage	Probit model
Kanyenji et al. [30]	Kenya	334	Soil Carbon Enhancing Practices	Probit model
Karidjo et al. [31]	Niger	149	Soil and Water Control Technology	Logit model
Kotu et al. [32]	Ghana	1284	Sustainable Intensification Practices	Probit model
Kpadonou et al. [33]	Burkina Faso	440	Water and Soil Conservation Measures	Probit model
Kurgat et al. [34]	Kenya	685	Sustainable Intensification Practices	Probit model
Lawin and Tamini [35]	Benin	2800	Agri-environmental practices	Endogenous treatment effects model
Makate et al. [36]	Zimbabwe and Malawi	1173	Climate Smart Agriculture	Regression with inverse probability weighting
Mekuriaw et al. [37]	Ethiopia	269	Water and Soil Conservation Measures	Logit model
Miheretu and Yimer [38]	Ethiopia	176	Sustainable Land Management	Logit model
Muchai et al. [39]	Kenya	291	Zai pit technology	Logit model
Mujeyi et al. [40]	Zimbabwe	386	Climate Smart Agriculture	Logit model
Muriu-Ng'ang'a et al. [41]	Kenya	351	Rain water harvesting	Logit model
Mutua-Mutuku et al. [42]	Kenya	248	Soil Fertility And Water Management	Tobit model
Ndagijimana et al. [43]	Burundi	160	Sustainable Land Management	Logit model
Ng'ang'a et al. [44]	Kenya	45	Sustainable Land Management	Probit model
Nguyen and Nguyen [45]	Vietnam	318	Organic farming	Exploratory factor analysis
Nigussie et al. [46]	Ethiopia	300	Sustainable Land Management	Probit model
Ntshangase et al. [47]	South Africa	185	Conservation Agriculture	Logit model
Olawuyi [48]	Nigeria	350	Conservation Agriculture	Heterogeneous treatment effects model
Paul et al. [49]	Guadeloupe	520	Compost	Logit model
Sileshi et al. [50]	Ethiopia	408	Water and Soil Conservation Measures	Probit model
Suwanmaneepong et al. [51]	Thailand	108	Organic farming	Logit model
Tinh et al. [52]	Vietnam	294	Good Agricultural Practices	Structural equation model
Tran et al. [53]	Vietnam	579	Climate Smart Agriculture	regression model
Tsige et al. [54]	Ethiopia	344	Conservation Agriculture	Logit model
Tu et al. [55]	Vietnam	202	Eco-friendly practices	Logit model
Zakaria et al. [56]	Ghana	300	Climate Smart Agriculture	regression model
Zeng et al. [57]	China	550	Sustainable Agricultural Technologies	Probit model
Zeweld et al. [58]	Ethiopia	350	Sustainable Land Management	Probit model
Zhang et al. [59]	China	924	Eco-friendly practices	Logit model

A total of 50 empirical studies from the year 2017 to 2021 carried out in different countries were included as research materials for this review. The inclusion and exclusion criteria for article screening is explained in detail in Figure 1 below. These studies were reviewed to determine the significant factors influencing SAP adoption. These factors were then coded into six dimensions of rural development processes by using NVivo 12 software. The dimensions of rural development are endogeneity, novelty, market governance, institutional, social capital and sustainability [7].

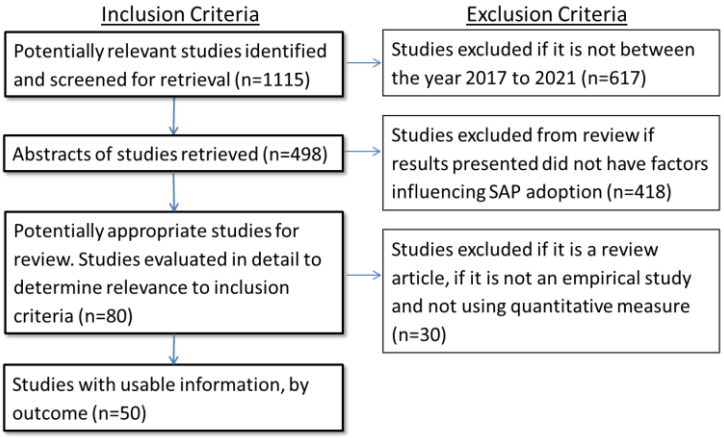

Figure 1. Inclusion and exclusion criteria for the article screening process.

4. Factors influencing adoption of SAP

4.1. Institutional and social capital

According to the empirical studies reviewed in this paper, the institutional dimension contains the most factors that influence the adoption of SAP as portrayed in Figure 2 below. The institutional dimension refers to the constellations that solve coordination problems and support cooperation among rural dwellers. Factors in this dimension that influences the adoption of SAP are access to public programs, access to credit and subsidies, frequent extension delivery system, training provided by local institutions, and membership within an agricultural cooperative. Institutional networks play a big role in directly and indirectly spreading the information regarding SAP to farmers. It can be described well through frequent visits from the extension agents, active participation of farmers in organizations, training and workshops, and group membership [10]-[13]-[14]-[18]-[19]-[21]-[22]-[25]-[26]-[37]-[56]. These are highly influential towards technology diffusion as it supports the dissemination of information regarding SAP. As for the dimension of social capital, it refers to the norms and networks which enables people to act collectively for a common purpose. Factors such as active involvement in social networking, involvement in collective action, relationship and communication with other farmers were found to be influential towards the adoption of SAP. This is because connections between farmers in social spheres act as sources of information for farmers to get introduced to practices that are sustainable [14]-[15]-[27]-[28]-[45]-[48]. This is especially useful towards introducing information on sustainable practices that were not familiar to the farmers.

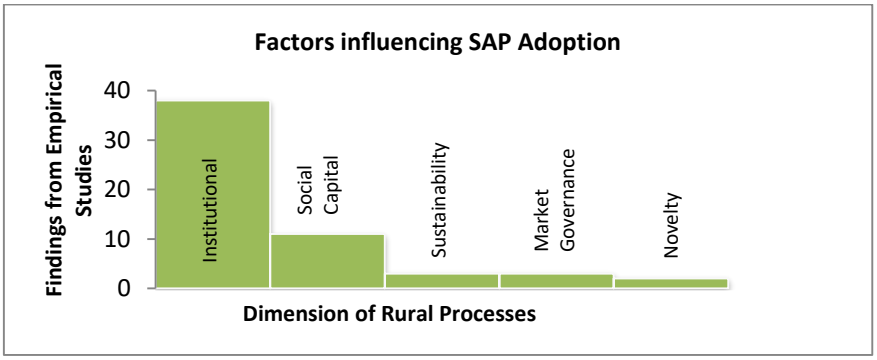

Figure 2. Factors influencing SAP adoption according to empirical studies reviewed.

4.2. Sustainability, market governance, endogeneity and novelty

According to the rural web conceptual model, the sustainability dimension refers to the multifunctionality of agriculture. This can be explained through the act of diversifying the income of farmers through practices that go alongside the agricultural produce. Factors such as off-farm income and diversification of activities were found to be influential in farmers' adoption of SAP [31]-[37]-[44]. As for market governance, this dimension refers to the capacity to control and strengthen existing markets. Factors such as market access and market integration were found to be influential towards the adoption of SAP [16]-[32]-[34]. With regards to the endogeneity dimension, it refers to the element of local context that affects rural economic activities. Factors such as the distance of farmland from home and the environmental condition of the farm were found to be influential towards the adoption of SAP among farmers. The environmental condition of the plot of farming land significantly affects adoption as arid or semi-arid agro-ecological zones adopt more climate-smart intense technology packages [19]. As for the novelty dimension, it refers to the re-patterning of resource use and the capacity to make new territorial connections that strengthen the local setting [60]. This dimension seeks to highlight new practices and insights that are carried out on the farm. However, findings from the review of literature have not been exploring the connection between novelty practices with the adoption of SAP. Table 2 below shows the SAP adoption factors found from the empirical studies that can be categorized under dimensions of sustainable rural development.

Table 2. SAP adoption factors related to dimensions of rural development.

Dimensions	Related SAP adoption factors
Institutional	Access to public programs, credit and subsidies, frequent extension delivery system, training provided by local institutions, membership within an agricultural cooperative
Social Capital	Active involvement in social networking, involvement in collective action, relationship and communication with other farmers
Sustainability	Off-farm income, diversification of activities
Market Governance	Market access, market integration
Endogeneity	Farm distance from home, environmental condition of farm location

5. Conclusions

Based on the finding of this paper, the adoption of sustainable agricultural practices conducted in most literature has proven that the factors mostly can be categorized into the dimensions of sustainable rural development. However, the sustainability, market governance, endogeneity dimensions were least associated with influential factors. Factors related to the novelty dimension were not recorded in any

findings from the reviewed studies. Therefore, the analysis done has highlighted the gap in the literature regarding factors influencing adoption. There is a need to address the connection between these dimensions with farmers' decision to adopt sustainable practices to acquire a comprehensive representation of the whole situation. Future research should consider exploring the relationship of novelty practices and agricultural multifunctionality with the adoption of sustainable agricultural practices.

References

[1] A. Nafeo Abdulai and A. Abdul-Rahaman, "Does conservation agriculture technology reduce farm household poverty? Evidence from rural Zambia," *African J. Sci. Technol. Innov. Dev.*, vol. 12, no. 4, pp. 477–487, 2020.

[2] M. R. Rahm and W. E. Huffman, "The Adoption of Reduced Tillage: The Role of Human Capital and Other Variables," *Am. J. Agric. Econ.*, vol. 68, no. 1, pp. 405–413, 1986.

[3] G. Feder and R. Slade, "The acquisition of information and the adoption of new technology," *World Bank*, 1982.

[4] G. Feder, R. E. Just, and D. Zilberman, "Adoption of agricultural innovations in developing countries: A Survey," vol. 225, 1984.

[5] E. Guinjoan, A. Badia, and A. F. Tulla, "The New Paradigm of Rural Development. Theoretical Considerations and Reconceptualization Using the 'Rural Web,'" *Boletín la Asoc. Geógrafos Españoles N.º*, vol. 71, pp. 495–500, 2016.

[6] P. Pugliese, "Organic farming and sustainable rural development: A multifaceted and promising convergence," *Sociol. Ruralis*, vol. 41, no. 1, pp. 112–130, 2001.

[7] J. D. Van Der Ploeg and T. Marsden, *Unfolding Webs : The Dynamics of Regional Rural Development*. Assen: Royal Van Gorcum, 2008.

[8] W. Mengist, T. Soromessa, and G. Legese, "Method for conducting systematic literature review and meta-analysis for environmental science research," *MethodsX*, vol. 7, 2020.

[9] B. C. Wallace, K. Small, C. E. Brodley, J. Lau, and T. A. Trikalinos, "Deploying an interactive machine learning system in an evidence-based practice center: abstrackr," *IHI'12 - Proc. 2nd ACM SIGHIT Int. Heal. Informatics Symp.*, pp. 819–823, 2012.

[10] A. N. Abdulai, A. Abdul-Rahaman, and G. Issahaku, "Adoption and diffusion of conservation agriculture technology in Zambia: the role of social and institutional networks," *Environ. Econ. Policy Stud.*, 2021.

[11] N. Adnan, S. M. Nordin, and A. Anwar, "Transition pathways for Malaysian paddy farmers to sustainable agricultural practices: An integrated exhibiting tactics to adopt Green fertilizer," *Land use policy*, vol. 90, no. September 2019, p. 104255, 2020.

[12] N. Adusumilli and H. Wang, "Analysis of soil management and water conservation practices adoption among crop and pasture farmers in humid-south of the United States," *Int. Soil Water Conserv. Res.*, vol. 6, no. 2, pp. 79–86, 2018.

[13] A. I. Agholor and M. Nkosi, "Sustainable water conservation practices and challenges among smallholder farmers in enyibe Ermelo Mpumalanga province, South Africa," *J. Agric. Ext.*, vol. 24, no. 2, pp. 112–123, 2020.

[14] A. Amare and B. Simane, "Determinants of smallholder farmers' decision to adopt adaptation options to climate change and variability in the Muger Sub basin of the Upper Blue Nile basin of Ethiopia," *Agric. Food Secur.*, vol. 6, no. 1, 2017.

[15] N. Arunrat, C. Wang, N. Pumijumnong, S. Sereenonchai, and W. Cai, "Farmers' intention and decision to adapt to climate change: A case study in the Yom and Nan basins, Phichit province of Thailand," *J. Clean. Prod.*, vol. 143, pp. 672–685, 2017.

[16] J. P. Aryal, D. B. Rahut, S. Maharjan, and O. Erenstein, "Factors affecting the adoption of multiple climate-smart agricultural practices in the Indo-Gangetic Plains of India," *Nat. Resour. Forum*, vol. 42, no. 3, pp. 141–158, 2018.

[17] F. Badu-Gyan, J. I. F. Henning, B. Grové, and E. Owusu-Sekyere, "Examining the social,

physical and institutional determinants of pineapple farmers' choice of production systems in Central Ghana," *Org. Agric.*, vol. 9, no. 3, pp. 315–329, 2018.
[18] M. Bavorová, İ. Unay-Gailhard, E. V. Ponkina, and T. Pilařová, "How sources of agriculture information shape the adoption of reduced tillage practices?," *J. Rural Stud.*, vol. 79, no. October 2019, pp. 88–101, 2020.
[19] G. Branca and C. Perelli, "'Clearing the air': common drivers of climate-smart smallholder food production in Eastern and Southern Africa," *J. Clean. Prod.*, vol. 270, p. 121900, 2020.
[20] E. Canales, J. S. Bergtold, and J. R. Williams, "Modeling the Choice of Tillage Used for Dryland Corn, Wheat and Soybean Production by Farmers in Kansas," *Agric. Resour. Econ. Rev.*, vol. 47, no. 1, pp. 90–117, 2018.
[21] E. Debie, "Smallholder farmers' decisions to the combined use of soil conservation practices in Tiwa watershed, Northwest highlands of Ethiopia," *Heliyon*, vol. 7, no. 1, 2021.
[22] B. Dhehibi, C. Zucca, A. Frija, and S. N. Kassam, "Biophysical and econometric analysis of adoption of soil and water conservation techniques in the semiarid region of sidi bouzid (Central Tunisia)," *New Medit*, vol. 17, no. 2, pp. 15–28, 2018.
[23] H. Etsay, T. Negash, and M. Aregay, "Factors that influence the implementation of sustainable land management practices by rural households in Tigrai region, Ethiopia," *Ecol. Process.*, vol. 8, no. 1, 2019.
[24] A. A. Faridi, M. Kavoosi-Kalashami, and H. E. Bilali, "Attitude components affecting adoption of soil and water conservation measures by paddy farmers in Rasht County, Northern Iran," *Land use policy*, vol. 99, 2020.
[25] Q. Han, K. H. M. Siddique, and F. Li, "Adoption of conservation tillage on the semi-arid Loess Plateau of Northwest China," *Sustain.*, vol. 10, no. 8, 2018.
[26] J. Hou and B. Hou, "Farmers' adoption of low-carbon agriculture in China: An extended theory of the planned behavior model," *Sustain.*, vol. 11, no. 5, 2019.
[27] A. Jabbar, Q. Wu, J. Peng, J. Zhang, A. Imran, and L. Yao, "Synergies and determinants of sustainable intensification practices in Pakistani agriculture," *Land*, vol. 9, no. 4, 2020.
[28] S. Jha, H. Kaechele, and S. Sieber, "Factors influencing the adoption of water conservation technologies by smallholder farmer households in Tanzania," *Water*, vol. 11, no. 12, 2019.
[29] Y. Ji, R. Ranjan, and M. Burton, "A bivariate probit analysis of factors affecting partial, complete and continued adoption of soil carbon sequestration technology in rural China," *J. Environ. Econ. Policy*, vol. 6, no. 2, pp. 153–167, 2017.
[30] G. M. Kanyenji, W. Oluoch-Kosura, C. M. Onyango, and S. K. Ng'ang'a, "Prospects and constraints in smallholder farmers' adoption of multiple soil carbon enhancing practices in Western Kenya," *Heliyon*, vol. 6, no. 3, 2020.
[31] B. Y. Karidjo, Z. Wang, Y. Boubacar, and C. Wei, "Factors influencing farmers' Adoption of Soil and Water Control Technology (SWCT) in Keita valley, a semi-arid Area of Niger," *Sustain.*, vol. 10, no. 2, 2018.
[32] B. H. Kotu, A. Alene, V. Manyong, I. Hoeschle-Zeledon, and A. Larbi, "Adoption and impacts of sustainable intensification practices in Ghana," *Int. J. Agric. Sustain.*, vol. 15, no. 5, 2017.
[33] R. A. B. Kpadonou, T. Owiyo, B. Barbier, F. Denton, F. Rutabingwa, and A. Kiema, "Advancing climate-smart-agriculture in developing drylands: Joint analysis of the adoption of multiple on-farm soil and water conservation technologies in West African Sahel," *Land use policy*, vol. 61, pp. 196–207, 2017.
[34] B. K. Kurgat *et al.*, "Drivers of sustainable intensification in Kenyan rural and peri-urban vegetable production," *Int. J. Agric. Sustain.*, vol. 16, no. 4–5, pp. 385–398, 2018.
[35] K. G. Lawin and L. D. Tamini, "Land Tenure Differences and Adoption of Agri-Environmental Practices: Evidence from Benin," *J. Dev. Stud.*, vol. 55, no. 2, 2019.
[36] C. Makate, M. Makate, and N. Mango, "Smallholder farmers' perceptions on climate change and the use of sustainable agricultural practices in the chinyanja triangle, Southern Africa," *Soc. Sci.*, vol. 6, no. 1, 2017.

[37] A. Mekuriaw, A. Heinimann, G. Zeleke, and H. Hurni, "Factors influencing the adoption of physical soil and water conservation practices in the Ethiopian highlands," *Int. Soil Water Conserv. Res.*, vol. 6, no. 1, pp. 23–30, 2018.
[38] B. A. Miheretu and A. A. Yimer, "Determinants of farmers' adoption of land management practices in Gelana sub-watershed of Northern highlands of Ethiopia," *Ecol. Process.*, 2017.
[39] S. W. K. Muchai, F. K. Ngetich, M. Baaru, and M. W. Mucheru-Muna, "Adoption and utilisation of Zai pits for improved farm productivity in drier upper eastern Kenya," *J. Agric. Rural Dev. Trop. Subtrop.*, vol. 121, no. 1, pp. 13–22, 2020.
[40] A. Mujeyi, M. Mudhara, and M. J. Mutenje, "Adoption determinants of multiple climate smart agricultural technologies in Zimbabwe: Considerations for scaling-up and out," *African J. Sci. Technol. Innov. Dev.*, vol. 12, no. 6, pp. 735–746, 2020.
[41] F. W. Muriu-Ng'ang'a, M. Mucheru-Muna, F. Waswa, and F. S. Mairura, "Socio-economic factors influencing utilisation of rain water harvesting and saving technologies in Tharaka South, Eastern Kenya," *Agric. Water Manag.*, vol. 194, pp. 150–159, 2017.
[42] M. Mutua-Mutuku, S. N. and Nguluu, T. and Akuja, M. and Lutta, and P. and Bernard, "Factors that influence adoption of integrated soil fertility and water management practices by smallholder farmers in the semi-Arid areas of eastern Kenya," *Africa's potential Ecol. Intensif. Agric.*, vol. 53, no. 9, pp. 1689–1699, 2017.
[43] M. Ndagijimana, A. Kessler, and M. V Asseldonk, "Understanding farmers' investments in sustainable land management in Burundi: A case-study in the provinces of Gitega and Muyinga," *L. Degrad. Dev.*, vol. 30, no. 4, pp. 417–425, 2019.
[44] S. K. Ng'ang'a, D. A. Jalang'o, and E. H. Girvetz, "Adoption of technologies that enhance soil carbon sequestration in East Africa. What influence farmers' decision?," *Int. Soil Water Conserv. Res.*, vol. 8, no. 1, pp. 90–101, 2020.
[45] V. H. NGUYEN and T. P. L. NGUYEN, "Intention to Accept Organic Agricultural Production of Vietnamese Farmers: An Investigation Using the Theory of Planned Behavior," *J. Asian Financ. Econ. Bus.*, vol. 7, no. 10, pp. 649–957, 2020.
[46] Z. Nigussie *et al.*, "Factors influencing small-scale farmers' adoption of sustainable land management technologies in north-western Ethiopia," *Land use policy*, vol. 67, 2017.
[47] N. L. Ntshangase, B. Muroyiwa, and M. Sibanda, "Farmers' perceptions and factors influencing the adoption of no-till conservation agriculture by small-scale farmers in Zashuke, KwaZulu-Natal province," *Sustain.*, vol. 10, no. 2, 2018.
[48] S. O. Olawuyi, "Adoption Decision and Welfare Impact of Eco-Friendly Agricultural Practices: Evidence from Smallholder Farmers in South-West Nigeria," *J. Manag. Inf. Decis. Sci.*, vol. 23, no. 5, pp. 590–611, 2020.
[49] J. Paul, J. Sierra, F. Causeret, L. Guindé, and J. M. Blazy, "Factors affecting the adoption of compost use by farmers in small tropical Caribbean islands," *J. Clean. Prod.*, vol. 142, 2017.
[50] M. Sileshi, R. Kadigi, K. Mutabazi, and S. Sieber, "Determinants for adoption of physical soil and water conservation measures by smallholder farmers in Ethiopia," *Int. Soil Water Conserv. Res.*, vol. 7, no. 4, pp. 354–361, 2019.
[51] S. Suwanmaneepong, C. Kerdsriserm, K. Iyapunya, and U. Wongtragoon, "Farmers' adoption of organic rice production in Chachoengsao province, Thailand," *J. Agric. Ext.*, vol. 24, no. 2, pp. 71–79, 2020.
[52] L. Tinh, P. T. M. Hung, D. G. Dzung, and V. H. D. Trinh, "Determinants of farmers' intention of applying new technology in production: The case of vietgap standard adoption in Vietnam," *Asian J. Agric. Rural Dev.*, vol. 9, no. 2, pp. 164–178, 2019.
[53] Agussabti, Rahmaddiansyah, Satriyo P, Munawar AA. 2020. *Data Br*. 29
[54] N. L. D. Tran, R. F. Rañola, B. Ole Sander, W. Reiner, D. T. Nguyen, and N. K. N. Nong, "Determinants of adoption of climate-smart agriculture technologies in rice production in Vietnam," *Int. J. Clim. Chang. Strateg. Manag.*, vol. 12, no. 2, pp. 238–256, 2019.
[55] M. Tsige, G. Synnevåg, and J. B. Aune, "Gendered constraints for adopting climate-smart

agriculture amongst smallholder Ethiopian women farmers," *Sci. African*, vol. 7, 2020.
[56] V. H. Tu, N. D. Can, Y. Takahashi, S. W. Kopp, and M. Yabe, "Modelling the factors affecting the adoption of eco-friendly rice production in the Vietnamese Mekong Delta," *Cogent Food Agric.*, vol. 4, no. 1, pp. 1–24, 2018.
[57] A. Zakaria, S. B. Azumah, M. Appiah-Twumasi, and G. Dagunga, "Adoption of climate-smart agricultural practices among farm households in Ghana: The role of farmer participation in training programmes," *Technol. Soc.*, vol. 63, no. April, p. 101338, 2020.
[58] Y. Zeng, J. Zhang, K. He, and L. Cheng, "Who cares what parents think or do? Observational learning and experience-based learning through communication in rice farmers' willingness to adopt sustainable agricultural technologies in Hubei Province, China," *Environ. Sci. Pollut. Res.*, 2019.
[59] W. Zeweld, G. Van Huylenbroeck, G. Tesfay, H. Azadi, and S. Speelman, "Impacts of socio-psychological factors on actual adoption of sustainable land management practices in dryland andwater stressed areas," *Sustain.*, vol. 10, no. 9, pp. 1–23, 2018.
[60] L. Zhang, X. Li, J. Yu, and X. Yao, "Toward cleaner production: What drives farmers to adopt eco-friendly agricultural production?," *J. Clean. Prod.*, vol. 184, no. 2018, pp. 550–558, 2018.