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Abstract

Agricultural mechanization, digital agriculture, and rural youth engagement are three megatrends occupying policymakers focused on agricultural transformation across Africa. Each of these topics is associated with debates on opportunities and risks and appropriate policy actions. While the contested nature of these debates becomes visible in (international) research discourses and policy fora, little is known about the viewpoints of local stakeholder groups on the national level. This can undermine policy-making, leading to "wrong" policies or policies that are not prioritized by local stakeholders, which, in turn, can undermine the implementation of such policies on the ground. This paper explores the viewpoints of 195 stakeholders from the public, private and third sectors (civil society) as well as from development partners and research bodies in four African countries, namely, Benin, Kenya, Nigeria, and Mali. The results suggest that the stakeholders perceive a need for agricultural transformation using mechanization and digital tools. However, they also perceive risks that have to be addressed. The results also reveal some hitherto neglected aspects. Examples include the role of animal traction as part of agricultural mechanization strategies and the continued appeal of state-led mechanization – despite the perception that such strategies do not work. Regarding digital agriculture, the stakeholders expressed high hopes – which have yet to materialize - but also concerns about a digital divide. Gender, age, and education influence the viewpoints on some topics, but not on others. Paying more attention to the perspectives of local stakeholder groups will help to choose and design the most promising policies and ensure their implementation on the ground.

Key Words

Policy beliefs, policymaking, agriculture, ICTs, tractors, technological change

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1. Introduction

After years of neglect, there are many new demands, opportunities, and efforts for the transformation of African agriculture (Bachewe et al., 2018; Jayne & Sanchez, 2021; Jayne et al., 2019). The Comprehensive African Agricultural Development Programme (CAADP) and the Agenda2063 of the African Union exemplify these efforts. According to the Future Agricultures Consortium (2021), CAADP is the "most ambitious and comprehensive agricultural reform effort ever undertaken in Africa" (para 1). As part of this transformation, agricultural mechanization, digital agriculture, and rural youth engagement are three megatrends occupying policymakers (Malabo Montpellier Panel, 2018, 2019). All of these trends are associated with lively and sometimes controversial debates on opportunities and risks, and appropriate policy actions.

Regarding agricultural mechanization, optimists see farmers, large and small, being freed from drudgery and reaping higher yields (Adu-Baffour et al., 2019; FAO & AUC, 2019; Sims et al., 2016), while pessimists fear that mechanization will benefit only large farms and cause rural unemployment and environmental problems (Daum & Birner, 2020). There are also debates on how best to promote mechanization, with some arguing that governments should provide subsidized tractors and run public hire centers, which are set up in various African countries, while others want to roll back the state's influence and focus on creating an enabling environment for private actors (Daum & Birner, 2017; Mockshell & Birner, 2017).

Regarding digital agriculture, optimists believe that digital tools will empower farmers with knowledge, optimize agricultural production, and enhance their access to upstream and downstream markets (Baumüller & Kah, 2019; Birner et al., 2019; Daum et al., 2021; Fabregas et al., 2019; Malabo Montpellier Panel, 2019; Reardon et al., 2019; Tsan et al., 2019). Many believe that digital agriculture will help to feed the world while making farming more environmentally friendly (Basso & Antle, 2020; Birner et al., 2019; Gudipati & Kwehera, 2019). Tsan et al. (2019) believe that digital agriculture "can be a game-changer in supporting and accelerating agricultural transformation across the continent" (p.17). In contrast, pessimists fear a digital divide, expecting a scenario where digital tools mainly benefit large farmers (Aker et al., 2016). They argue that farmers who share data will become more dependent on large companies (Bronson & Knezevic, 2016; Fraser, 2020; Mehrabi et al., 2021).

Youth engagement in agriculture is also discussed controversially. Their viewpoints and future are an area of concern for many given the "youth bulge" in several African countries,

which is associated with the need to generate millions of new jobs (Mueller & Thurlow, 2019). While some argue that the rural youth find farming unattractive (Bezu & Holden, 2014; Sumberg et al., 2017) and perceive it to be a “last resort, and for many, not an option at all” (Tadele & Gella, 2012, p. 33), this view has been challenged by several more recent studies showing that farming may not be as unattractive as often assumed (LaRue et al., 2021; Rietveld et al. 2020; White, 2020). Moreover, there are controversies over how “attractive” farming looks like, in particular, what degree of technologisation would make farming attractive and what governments should do in this regard (Daum, 2019).

While the aforementioned debates are crystalizing in (international) research journals and policy fora, little is known on the viewpoints of local stakeholders groups at the national and sub-national levels, including the public administration, farmer organizations, private entrepreneurs, research bodies, and development partners. Moreover, little is known on whether stakeholders' perceptions differ by gender, age, and education level. A lack of knowledge on the viewpoints of local stakeholder groups can lead to separate worlds of policymaking, undermining policy processes (Mockshell & Birner, 2017). This lack can also lead to policy choices and policies by government and development partners that are not prioritized by local stakeholders, which, in turn, can undermine the implementation of policies on the ground (Harris et al., 2017; Matland, 1995).

This paper explores the viewpoints of local stakeholder groups in four African countries, namely, Benin, Kenya, Mali, and Nigeria concerning three topics: agricultural mechanization, digital agriculture, and youth in agriculture. In total, 195 respondents representing different categories of stakeholders from the public, the private, the third sector as well as development partners and research bodies were selected for responses on some aspects of the above broad topics. Section 2 provides an overview of the case study countries, the sampling, and the methods used. Section 3 presents viewpoints of the local stakeholder groups on agricultural mechanization, digital agriculture, and youth in agriculture. Section 4 discusses the findings and concludes

2. Research countries, methods, and sampling

2.1. Research countries

This paper is based on data collected in four African countries: Benin, Kenya, Mali, and Nigeria. The case study countries were chosen to reflect different geographical areas, in particular, Western and Eastern Africa, and different degrees of mechanization and digitalization. Regarding mechanization, Kenya can be considered to be more "mechanized" than Benin, Mali, and Nigeria. In Kenya, 13% of farmers own or hire tractors (Kirui, 2019) and 33% of farmers own animal traction (De Groote et al., 2018). In Nigeria, 4% of farmers own or hire tractors (Takeshima & Lawal, 2018). In Benin, 76 % of the land is cultivated by hand; 23% using animal traction, and 1% with tractors (Daum et al., 2020). In Mali, only 0.4% of farmers own a tractor while 40% of the land is cultivated with animal traction (Daum et al., 2020). Regarding the use of digital tools, Nigeria and Kenya, the latter of which is often described as the Silicon Savannah, seem to be more advanced compared to Benin and Mali. The Mobile Connectivity Index, which is based on indicators such as digital infrastructure, affordability, consumer readiness as well as content and service, gives a sense of the degree of digitalization in different countries. On this index, which ranges from 0 to 100, Kenya scores 50 points and Nigeria scores 47 points, while Benin scores 38 points, and Mali 30 points (Bahia & Suardi, 2019).

2.2. Sampling and methods

To obtain data on prevalent policy beliefs in these different countries, 195 interviews with stakeholders from the domestic agricultural policy landscape were conducted. Interviewees were chosen through purposive sampling so that relevant stakeholders from different types of local stakeholder groups and their opinions could be captured. Additional interviewees were identified using snowball sampling. The interviewees can be classified into five groups: 1) "Third Sector" (including farmer organizations, youth associations, women's associations, and domestic NGOs); 2) "Public Sector" (including intergovernmental organization, national and local governmental body); 3) "Development partners" (including donors, development organization and international non-governmental organization); 4) "Research" (including public and private universities, research institutes and training centers) and 5) "Private" (including private companies). Table 1 provides an overview of the distribution of the interviewed stakeholders.

Table 1. Interviewed stakeholders in Benin, Kenya, Mali, and Nigeria.

Country	Third Sector	Public Sector	Development Partners	Research	Private	Total
Benin	8	12	9	21	0	50
Kenya	2	8	2	5	2	19
Mali	50	7	7	10	4	79
Nigeria	5	21	5	9	8	50
Total	65	48	23	45	14	195

Respondents were asked about their policy beliefs in face-to-face interviews conducted by staff of the respective national agricultural research system organization (NARS) with the help of a standardized questionnaire. The interviewers emphasized that the respondents should state their personal opinion, which does not need to correspond with the position of their organization. Respondents were asked questions on their attitudes and preferred budget allocations regarding agricultural mechanization, digital agriculture, and youth in agriculture. Moreover, respondents were asked to which extent they agree/disagree with different statements regarding these topics using 7-points Likert-Scales, where 1 indicates full disagreement and 7 full agreement.

3. Results

Table 2 shows the preferred budget allocation of the local stakeholder groups by country and type of stakeholders. The table shows strong support for agricultural extension (on average 24% of the hypothetical budget allotted) and input subsidies (on average 22% of the allocated budget). This is followed by agricultural mechanization (15%) and youth (11%) as well as environmental programs (10%) and lastly digital agriculture (9%). In Benin and Kenya, the extension system received the highest share of the hypothetical budget, while in Nigeria and Mali, most of the budget was allocated to input subsidies. Youth topics received the highest budget in Nigeria (almost double compared to Mali) and environmental protection was highest on the budget list in Benin (more than thrice as compared to Mali)

Supporting agricultural extension seems to be particularly popular among development partners but there are no significant differences between the stakeholder groups. Inputs subsidies are most popular among third sector stakeholders such as farmer organizations (26%) and private actors (24%) and least popular among development partners (15%). Mechanization is most popular among private actors (19%) but least popular among third sector stakeholders (13%). There are no significant differences regarding youth in agriculture and digital agriculture between the stakeholder types. It is important to note that budget allocation decisions are only a proxy but not an ideal indicator of policy priorities. For example, the relatively smaller budget share for digital agriculture may also be because respondents think that digital agriculture should be led by market forces, with governments mainly providing the institutional framework conditions, which may require no large budget to be set up.

Table 2. Preferred budget allocation

Imagine the public agricultural budget is 10% of the overall budget. How would you allocate it? (%)	Total (n=195)	Country					Type					
		Benin (n=50)	Nigeria (n=50)	Kenya (n=19)	Mali (n=79)	Kruskal-Wallis	Third Sector (n=65)	Public (n=48)	Development partners (n=23)	Research (n=45)	Private (n=14)	Kruskal-Wallis
Extension	24	29	18	29	24	0.00***	22	25	28	25	23	0.38
Input subsidies	22	13	23	17	28	0.01*	26	21	15	19	24	0.27
Mechanization	15	16	18	15	13	0.02*	13	15	14	18	19	0.06**
Youth	11	11	15	10	8	0.00***	11	12	10	10	9	0.48
Environment	10	16	7	12	5	0.00***	7	10	12	12	8	0.00**
Digital agriculture	9	9	9	9	9	0.06*	12	8	8	8	8	0.97
Others	10	7	7	9	13	0.38	10	9	13	8	9	0.78

Table 3 shows the results of an OLS regression, which explores how the budget allocation is related to gender, age, and the education level of the respondents, controlling for the type of stakeholder. This approach has been chosen because of the nature of the data and because we rely on strong assumptions of linearity in the parameters and normality of standard errors. Robust standard errors account for heteroscedasticity, and pairwise correlation coefficients were calculated to avoid multicollinearity.

Table 3 shows that the budget allocation is to some degree correlated with gender, age, and education. Compared to male respondents, female respondents allocated on average a significantly higher budget share to agricultural extension services and a lower share to inputs. With increasing age, respondents allocated a significantly higher budget to extension and environmental protection but a lower share to digital agriculture. More educated respondents allocated less money to input subsidies but more to extension and environmental protection.

Table 3: Ordinary least squares regression explaining budget allocation by gender, age, and education

Variable	Extension	Inputs	Mechanization	Youth	Environment	Digital Ag
Gender (Female)	8.20 (3.7)**	-6.80 (2.8)**	-0.01 (2.6)	0.24 (1.7)	0.90 (1.9)	0.68 (1.8)
Age (Years)	0.31 (0.1)**	-0.03 (0.2)	0.06 (0.1)	-0.02 (0.1)	0.11 (0.1)**	-0.24 (0.1)*
Education (Level)	1.19 (0.7)*	-2.61 (0.8)***	0.33 (0.5)	0.15 (0.4)	0.54 (0.3)*	-0.15 (0.3)
Control Type	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Constant	4.19 (6.5)	32.9 (10.0)***	8.80 (3.8)**	11.3 (4.1)***	0.64 (2.4)	23.4 (7.8)***
Observations	*180*	*180*	*180*	*180*	*180*	*180*
R-squared	*0.09*	*0.08*	*0.07*	*0.01*	*0.14*	*0.08*

Rounded robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 4 shows that 93% of all respondents have a positive attitude towards agricultural mechanization. While agricultural mechanization is often used as a synonym with tractorization, respondents across all countries see a continued scope for the use of animal traction as well, as indicated by the preferred budget allocation of the respondents, ranging between 9-52%. In Benin, mechanical traction was heavily favored (91%), while stakeholders in Mali wished for more money to be allocated to animal traction (52%) as compared to tractors. Animal traction seems to be particularly popular among stakeholders from the third sector (43%), which included farmer organizations, while public stakeholders, development partners, and stakeholders from research mostly prefer mechanical traction. Overall, mechanical traction seems more popular among all stakeholder categories, however.

Table 4. Attitude and preferred budget allocation on mechanization

	Total (n=195)	Country					Type					
		Benin (n=50)	Nigeria (n=50)	Kenya (n=19)	Mali (n=79)	Kruskal-Wallis	Third Sector (n=65)	Public (n=48)	Development Partners (n=23)	Research (n=45)	Private (n=14)	Kruskal-Wallis
Overall attitude on mechanization (%)												
Pro	**93**	100	85	100	95		100	94	96	96	65	
Neutral	**2**	0	9	0	0	0.00***	0	4	0	0	7	0.00***
Contra	**5**	0	6	0	5		0	2	4	4	29	
Budget allocation (%)												
Animal traction	**31**	9	23	18	52	0.00***	43	26	20	23	32	0.00***
Mechanical traction	**69**	91	77	82	48		57	74	80	77	68	
Budget allocation (%)												
Imports, subsidies, hire	**48**	46	51	60	46	0.01*	46	53	53	45	50	0.20
Enabling environment	**52**	54	49	40	54		54	47	47	55	50	

Table 4 confirms the contested role of the public and private sector during agricultural mechanization, with respondents preferring around 48% of the hypothetical budget to be used to publicly purchase machinery, subsidize machinery or set up state-run mechanization service centers, while 52% of the budget was earmarked for supportive infrastructure and the enabling environment. There were no significant differences between the five stakeholder groups on this aspect.

Table 5 shows that gender and education influence the preferred support for mechanical traction versus animal traction. Female respondents allocated a significantly larger share of the hypothetical budget to mechanical traction. Also, the more educated respondents were more inclined to support mechanical traction over animal traction. Gender, age, and education do not seem to influence whether respondents prefer to directly support mechanization (importing machinery, distributing subsidies machinery, or setting up machinery hire centers) or indirectly support it by creating an enabling environment.

Table 5: Ordinary least squares regression explaining budget allocation on mechanization by gender, age, and education

Variable	Share budget mechanical traction (vs. animal traction)	Share budget enabling environment (vs. imports/subsidies/hire)
Gender (Female)	9.66 (5.44) *	0.73 (4.80)
Age (Years)	0.02 (0.18)	0.07 (0.15)
Education (Level)	5.53 (0.88) ***	-0.15 (0.73)
Control Type	*Yes*	*Yes*
Constant	42.21 (8.73) ***	51.12 (7.91) ***
Observations	*183*	*183*
R-squared	*0.33*	*0.03*

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 6 shows which ways the respondents perceive to be the best to promote agricultural mechanization. The respondents were asked to rank the different options on a scale from 1 to 7 (with 7 being the highest). Across the different stakeholder groups, service markets are perceived to be the most promising option. Cooperatives were ranked second. Using digital tools (e.g. Uber for tractors) and land consolidation were perceived to be less useful.

Table 6: Assessment of the potential of different ways to promote agricultural mechanization (n=180)

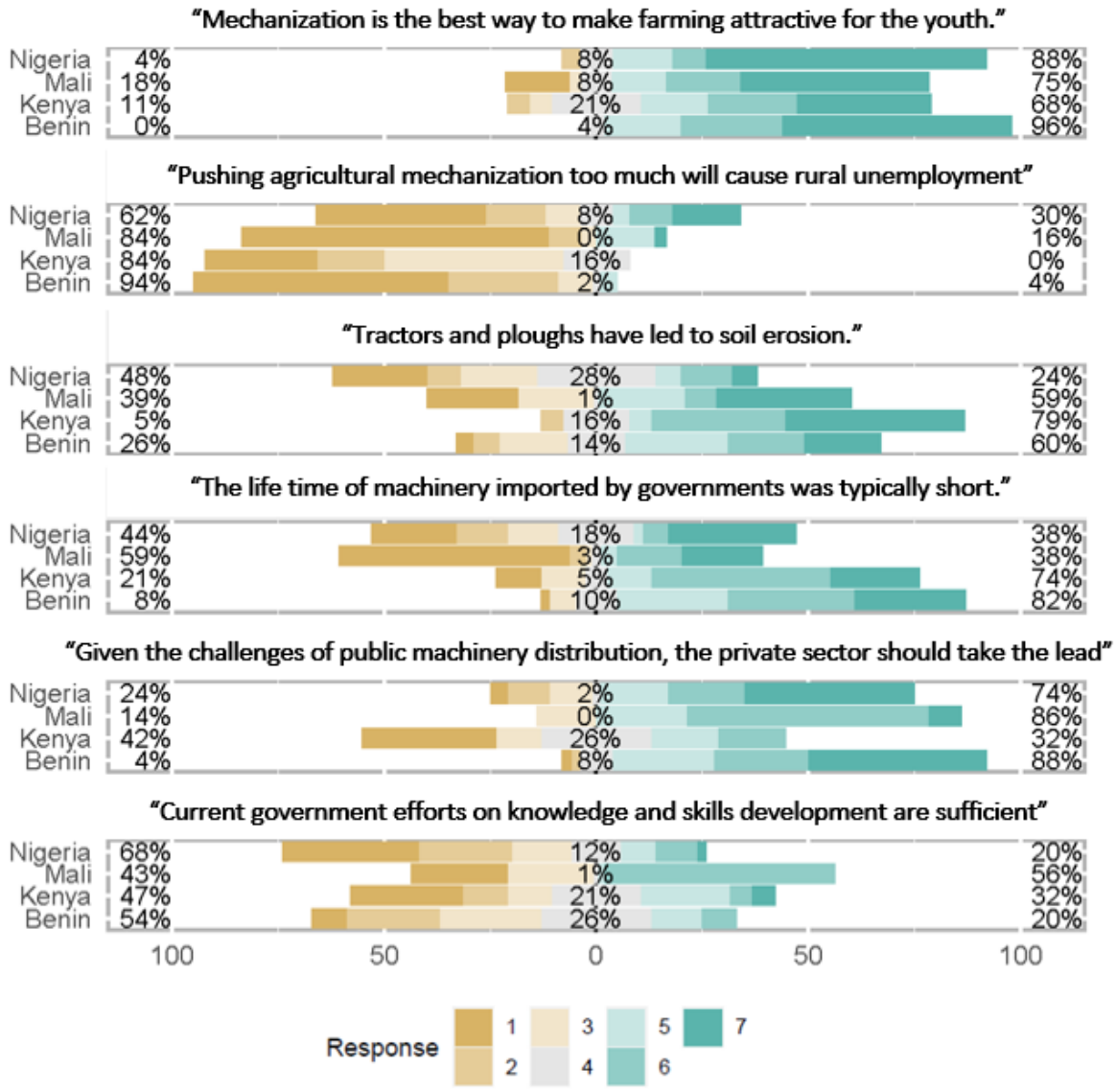
	Average	Third Sector	Public Sector	Development Partners	Research	Private	Kruskal-Wallis
Service markets	5.7	5.9	5.6	6.3	5.6	5.0	0.02**
Cooperatives	5.3	4.7	5.8	5.9	5.6	4,9	0.00***
Digital tools	4.8	4.7	4.2	5.0	5.2	5.1	0.02**
Land consolidation	4.5	3.8	4.5	4.7	5.3	4.1	0.18

Respondents were asked to rate the potential of the different ways on a scale from 1 to 7.

Figure 1 shows the level of disagreement/agreement of the stakeholders with different statements regarding the effects of agricultural mechanization. The figure confirms that the local stakeholder groups in the four countries have mostly positive views on mechanization. For example, there seems to be a strong consensus that mechanization can help to make farming more attractive for young people (68-96% agreements). Few of the stakeholders are concerned about the potential negative effects of mechanization on employment (0-30% agreements). The views on the effects of the use of tractors and plows on soil erosion are more ambiguous: while 79% of the stakeholders in Kenya agreed to the respective statement, this share was only 24% in Nigeria.

Figure 1 also shows stakeholders' views on the optimal role of the public and private sectors during agricultural mechanization. 38-82% of the respondents, viewed state-led mechanization efforts such as the importation and distribution of tractors to be unsustainable. These shares were particularly high in Kenya and Benin, where 74% and 82% of the respondents, respectively, agreed with the statement that the “lifetime of machinery imported by governments was typically short”. In Benin, the perceived limited sustainability of past state-led mechanization may explain why 88% of the respondents want the private sector to “lead” mechanization. This is not the case in Kenya, however, where only 32% want the private sector to take the lead. In Nigeria and Mali, only 38% of the respondents agreed with the statement that the “lifetime of machinery imported by governments was typically short”. Still, in both countries, the stakeholder wished the private sector to “lead” mechanization. Across the countries, stakeholders perceived government efforts on knowledge and skill development to support mechanization (such as training machinery technicians and operators) to be limited. Depending on the country, between 43 to 68% found public efforts to be insufficient.

Figure 1. Rate of agreement with statements on agricultural mechanization



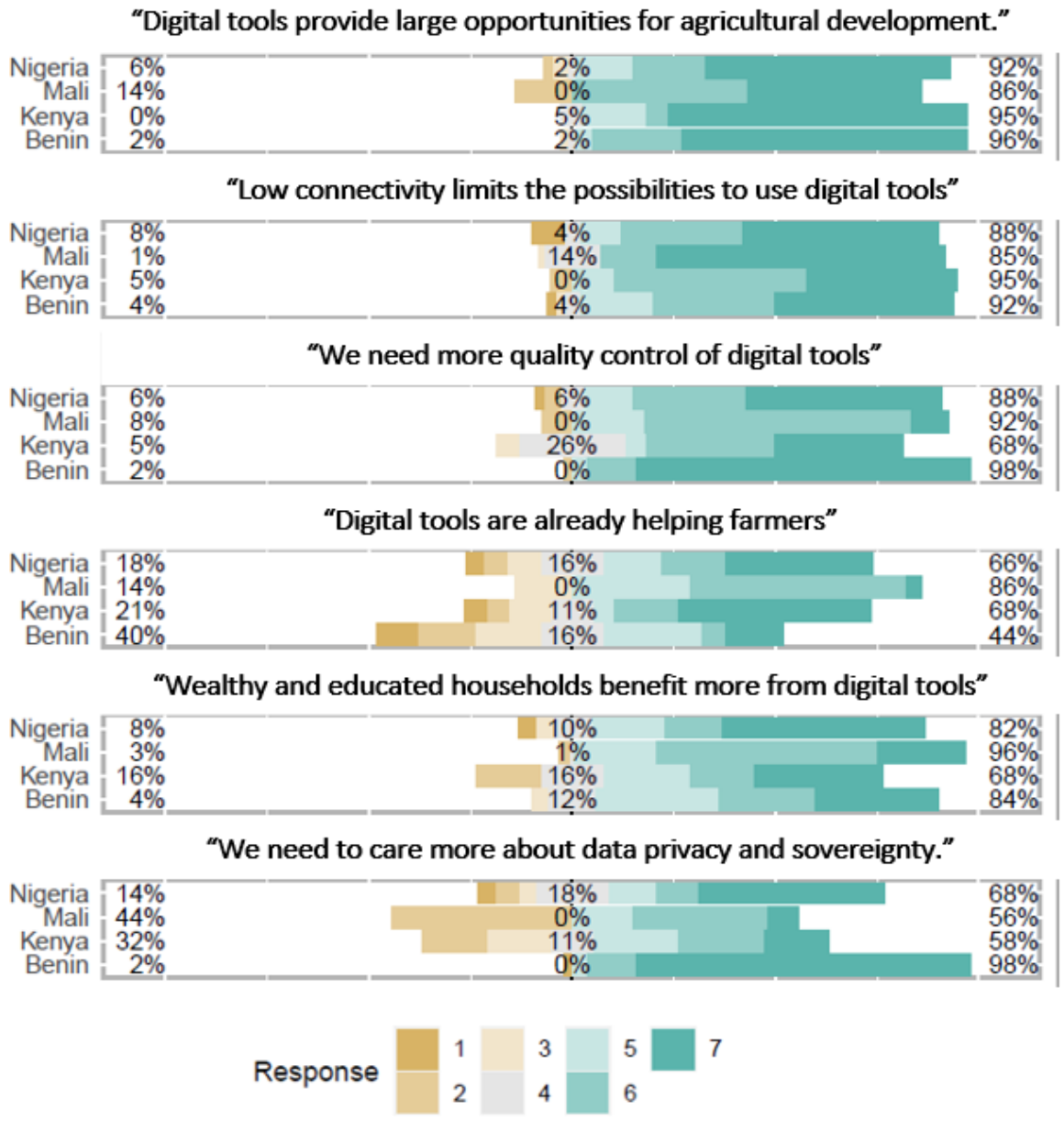
Notes: Sample size: 195. Likert type rate of disagreement/agreement with 1=total disagreement and 7=total agreement.

Figure 2 shows the viewpoints of the local stakeholder groups on the opportunities and challenges of digital agriculture. A large share of the respondents (86-96%) find digital tools to provide "large opportunities for agricultural development", however, the share of respondents agreeing that such tools are "already helping farmers" is lower (44-86%). Moreover, the stakeholder groups perceived digital tools to mostly benefit "large and educated farmers". The share of respondents agreeing with the respective statement was as high as 96% in Mali, but significantly lower in Kenya, where only 68% agreed with this opinion.

Between 88 and 95% of stakeholders perceived limited connectivity as a constraint to digital agriculture. Stakeholders also agreed with the statement that more quality controls regarding the content of digital tools are needed. The importance of data privacy and

sovereignty differed largely across the countries. For example, 98% of the stakeholder in Benin agreed with the statement that "we need to care more about data privacy and sovereignty" but in Mali, 44% disagreed with this opinion.

Figure 2. Rate of agreement with statements on digital agriculture



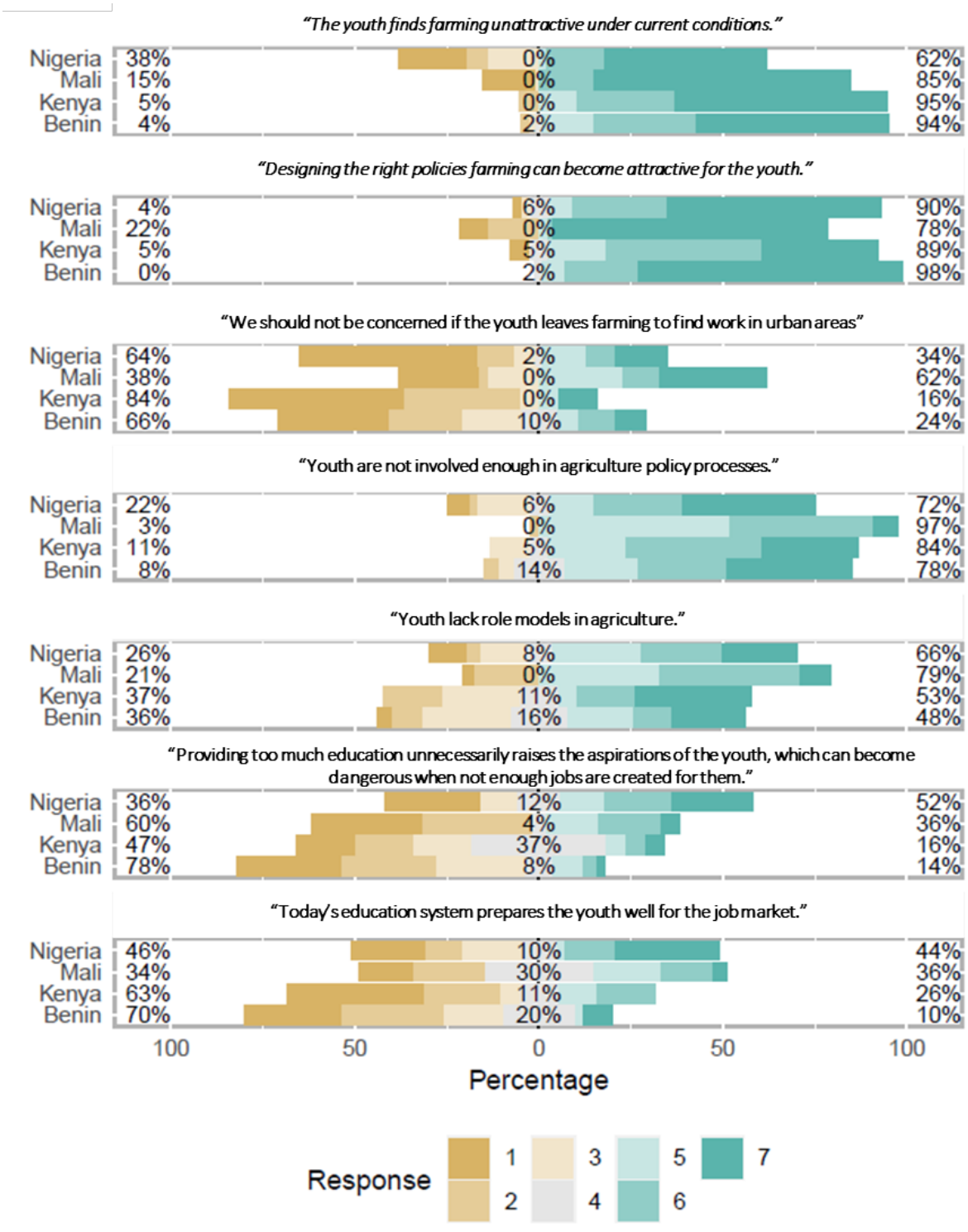
Notes: Sample size: 195. Likert type rate of disagreement/agreement with 1=total disagreement and 7=total agreement.

Figure 3 shows the extent to which the local stakeholder groups agree/disagree with different statements on youth in agriculture. The figure shows that there is a strong agreement with the narrative that the youth find farming unattractive (ranging from 62% in Nigeria to 95% in Kenya). Disaggregating the data by stakeholder groups reveals that this narrative is particularly popular among development partners (98% approval) but less

popular among the private sector actors (69%) (data not shown). Outmigration of the youth towards urban centers seems to be a concern in Benin, Kenya, and Nigeria but not in Mali.

Overall, there is great optimism that farming can become attractive for the youth (78-98%). However, there is also a large share of respondents who feel that the youth is not involved enough in policy processes (72-97%), and a significant share perceived the youth to lack role models in agriculture (48-79%). There is a perception that the country's education systems do not prepare the youth adequately for the job market, in particular in Benin (70%) and Kenya (63%).

Figure 3. Rate of agreement with statements on youth in agriculture



Notes: Sample size: 195. Likert type rate of disagreement/agreement with 1=total disagreement and 7=total agreement.

4. Discussion and Conclusion

Agricultural mechanization, digital agriculture, and the role of rural youth engagement in agriculture are three top priorities of policymakers across Africa in the context of agricultural transformation. In academia, all of the megatrends are surrounded by controversies. However, little is known about the perspectives of local stakeholder groups regarding these different topics. This paper has explored how these three megatrends are perceived by local stakeholder groups in four African countries, which can help to design better policies.

The results suggest that local stakeholder groups are largely in favor of supporting agricultural mechanization, suggesting a window of opportunity to focus policy efforts to support much-needed African agricultural mechanization (FAO & AUC, 2019). While mechanization is often perceived as tractorization, the results emphasize that mechanization goes beyond the use of mechanical tools and suggests that there is continued scope for animal traction - at least in some countries. The role of animal traction has been largely neglected by policymakers and academia alike, despite some research showing that overcoming the animal traction stage may be difficult (Pingali et al., 1987). Animal traction may be more accessible to smallholder farmers but equally requires policy support (e.g., veterinary services). Policymakers and researchers should carefully assess the advantages and disadvantages of tractors vis-à-vis animal traction while taking into account socio-economic and agro-ecological considerations and the respective farming system (Daum & Birner, 2020; Pearson & Vall, 1998), without being distracted by the political appeal of “modern” tractors (Daum & Birner, 2017).

The local stakeholder groups found that past state-led mechanization programs often failed and were unsustainable. This reflects much of the literature on the challenges of state-led programs, which highlights that such programs were often characterized by governance challenges and machinery breakdowns (Daum & Birner, 2020; FAO & AUC, 2019; Pingali, 2007). Despite acknowledging the bad track record of past state-led mechanization efforts, a large share of the local stakeholders – from all stakeholder groups, including private sector actors - found state-led mechanization to be attractive to a considerable degree. This may be due to the perceived slow progress of private-sector-led mechanization or the political economy of large-scale public mechanization programs (Daum & Birner, 2017; Mockshell & Birner, 2017). This is problematic given the emerging evidence that such state-sponsored programs are again characterized by governance challenges (e.g., Daum & Birner, 2017) and show limited success in reaching smallholder farmers (e.g., Cabral, 2021). Efforts are needed to help develop - and create the political will to pursue - alternative visions and pathways to promote sustainable mechanization. Historical evidence from today’s highly

mechanized countries (e.g. Daum et al., 2018) and contemporary evidence from Asian countries (e.g., Diao et al., 2020), which have mechanized more rapidly as compared to Africa, show that governments have played a key role to support market-led mechanization (Daum & Kirui, 2021). A second-best approach would be to focus on which governance solutions are needed to enhance government mechanization programs (Daum & Birner, 2020).

The local stakeholder groups believe in the transformative power of digital agriculture, sharing the optimistic view prevalent across much of the agricultural economics literature (Baumüller & Kah, 2019; Chavula, 2014; Nakasone et al., 2014; Tsan et al., 2019). However, the local stakeholder groups also believe that the actual impacts of digital agriculture may be more modest, confirming Bateki et al. (2021), Daum et al., (2021), and Deichmann et al. (2016), among others. Moreover, they expressed fears about a digital divide: a large share of the local stakeholders found that digital agriculture, thus far, mainly benefits large and wealthy farmers. This may be partly because of the low levels of digital literacy among smallholder farmers; however, large and wealthy farmers may also be able to draw more benefits from the use of such tools as they are less resource-constrained (Bateki et al., 2021; Daum et al., forthcoming). The fears expressed by the domestic stakeholders confirm emerging concerns in the literature (Aker et al., 2016; Bateki et al., 2021; McCampbell et al., 2021). This is problematic because it may undermine inclusive agricultural transformation in Africa. Confirming much of the literature on digital agriculture (e.g. Daum, 2019; FAO, 2019; Mehrabi et al., 2021; Nakasone & Torero, 2016), the local stakeholder groups find connectivity to still constrain digital development. As shown by the FAO (2019), there are large differences in connectivity between urban and rural areas, and connectivity is often not affordable. Potential solutions to enhance connectivity in rural areas are “Universal Access/Universal Service Funds” (Birner et al., 2019). Mirroring concerns by Baumüller (2018) and others, the local stakeholders also seem to have some doubts about the quality of some digital devices for farmers and demand for more quality control. Efforts related to standards and testing as well as digital literacy – by the public, private, or third-sector governance – are needed to ensure that farmers are empowered to understand the benefits and risks of using digital agriculture. Viewpoints on data sovereignty and ownership are more mixed: while most stakeholders in Benin and Nigeria found this to be an important topic to be addressed, stakeholders in Kenya and Mali found this topic to be of less relevance. This is problematic because neglect of data governance from policymakers may lead to skewed power relations within agricultural value chains, disadvantaging smallholder farmers (Daum et al., forthcoming; McCampbell et al., 2021). There is a need for research and policy dialogue on how to enhance the governance of digital agriculture to ensure it contributes to sustainable and inclusive agricultural transformation in Africa.

The results confirm more dire outlooks on the attractiveness of farming for the youth under current conditions (e.g. Bezu & Holden, 2014; Sumberg et al., 2017; Tadele & Gella, 2012). However, the viewpoints of the local stakeholders also show great optimism that farming can be made more attractive, resonating with empirical evidence (LaRue et al., 2021; Rietveld et al. 2020; White, 2020). According to the local stakeholders, this requires a larger involvement of the rural youth in policy processes, a need that is stressed in various studies (e.g. Daum, 2019; LaRue et al., 2021). In Malawi, for example, Kadzamira & Kazembe (2015) found youth to "remain on the periphery of agricultural policy-making". Integrating agricultural aspects into national youth policies may be one entry point to help make farming more attractive (Daum, 2019; LaRue et al., 2021; te Lintelo, 2012) – while keeping in mind that retaining youth in agriculture constitutes a means to an end and not a goal in itself. The considerable interest of the stakeholders in youth issues suggests that there is a great momentum with which to design policies and programs. Researchers and civil society actors should engage in policy dialogues to harness this momentum and ensure that such policies and programs do reflect the aspirations of the rural youth.

Overall, the results also show that gender, age, and education influence the stakeholder viewpoints, indicating that the composition of the domestic policy landscape regarding these parameters may influence policy processes and action. In particular, as compared to male respondents, female respondents wanted a significantly higher budget to be allocated to extension services but a lower budget share to input subsidies. Female respondents were also more likely to support mechanical traction as compared to animal traction. Giving more voice to female stakeholders in domestic policy processes is thus likely to change the type of policies pursued, potentially making them more relevant for the large share of female farmers and female farm laborers across Africa (Palacios-Lopez et al., 2017). The age of decision-makers also matters. Older respondents allocated a significantly higher budget to extension and environmental protection but less money for digital agriculture. Educational background and attainment may matter, too. As compared to less educated respondents, the more educated ones allocated less money to input subsidies - which are widespread across Africa but whose effectiveness and efficiency are highly contested (Holden, 2019; Kato & Greeley, 2016). Likewise, more educated respondents allocated more money to environmental protection.

Having an ear on the ground – that is, understanding the perspectives of local stakeholder groups - is important for a country's governments to choose and design the right policies and ensure their implementation on the ground. Paying more attention to the perspectives of different types of local stakeholders can also help to enrich scientific debates, in particular, debates on transformative technological change, as in the case of agricultural

mechanization and digital agriculture, and debates on societal changes, such as the role of the rural youth. The engagement of different stakeholder groups as part of participatory processes is needed to ensure development pathways that contribute to sustainable and inclusive agricultural transformation in Africa.

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