Dieses Dokument ist eine Zweitveröffentlichung (Verlagsversion)

This is a self-archiving document (published version)

Nyong Princely Awazi, Jude Ndzifon Kimengsi, Gadinga Walter Forje

Gender-differentiated capture of agro-based climate adaptation interventions : implications for agricultural systems and practices in Cameroon's Western highlands

Erstveröffentlichung in / First published in:

SN social sciences. 2024, 4. Art-Nr. 116. Springer Nature. ISSN: 2662-9283

DOI: https://doi.org/10.1007/s43545-024-00894-w

Diese Version ist verfügbar / This version is available on:

https://nbn-resolving.org/urn:nbn:de:bsz:14-qucosa2-989037

Dieses Werk ist lizenziert unter einer Creative Commons Namensnennung 4.0 International Lizenz.
This work is licensed under a Creative Commons Attribution 4.0 International License.

SLUB
Wir führen Wissen.

TECHNISCHE UNIVERSITÄT DRESDEN

QUCOSA
Quality Content of Saxony

SN Social Sciences (2024) 4:116
https://doi.org/10.1007/s43545-024-00894-w

ORIGINAL PAPER

Gender-differentiated capture of agro-based climate adaptation interventions: implications for agricultural systems and practices in Cameroon's Western highlands

Nyong Princely Awazi[1,2] · Jude Ndzifon Kimengsi[3,4] · Gadinga Walter Forje[5]

Received: 25 September 2023 / Accepted: 14 April 2024 / Published online: 10 June 2024
© The Author(s) 2024

Abstract

In climate change adaptation, studies exist on extension interventions in sub-Saharan Africa, albeit the dearth of scientific evidence on the differential "capture[1]" of agro-based adaptation packages. This paper contributes to provide evidence by (1) analyzing the typology of agro-based climate adaptation packages, and (2) exploring gender variations in the capture of agro-based climate adaptation packages. We use key informant interviews (N=89) and focus group discussions (N=14) to obtain data, analyzed using content analysis. Variations were observed in the capture of agro-based adaptation packages introduced by state and non-state actors. While men (adult male) mostly employed dominant information, women (adult female) drew from group formation. Agro-based adaptation capture led to major shifts in agricultural systems in the western highlands from monocropping to mixed cropping, mixed farming and agroforestry systems. The results show changes in agricultural systems from monocropping to mixed cropping. It was observed that women (adult female) and youths (both male and female) capture adaptation strategies encouraged by state agencies than the men (adult male) who adopt various adaptation strategies by both state agencies and non-governmental organizations. While these findings shed light on the dynamics of gender differentiated capture, it further calls for an in-depth exploration of other factors which shape agricultural system change.

Keywords Gender · Extension services · Climate adaptation · Agricultural systems and practices · Western highlands of Cameroon

[1]Drawing from the well-known elite capture literature (Ribot 2004; Lund and Saito-Jensen 2013), we define gender differentiated capture as a situation in which well-placed male or female actors monopolize resources intended for less privileged members and/or dominate participation and decision-making processes in the frame of climate adaptation interventions. The intention in this article is to understand whether it is the men or women who 'capture' agro-based adaptation intervention packages more, and the conditions under which this occurs.

Extended author information available on the last page of the article

Introduction

Climate change is having major adverse impacts on the agricultural sector across the world (FAO 2018). With extreme weather/climate events predicted to worsen in the coming decades—should the business-as-usual trajectory prevail, the agricultural sector is going to be the hardest hit as slight shifts in climate/weather patterns have been shown to have major repercussions on crop growth and productivity (IPCC 2018). This calls for swift action in order to avert the risk. One of the actions capable of mitigating the risk is the adoption and implementation of agro-based climate adaptation packages introduced by state and non-state actors geared towards aiding farmers and livestock keepers reign in on the adversities of climate change (Chikaire et al. 2011; Diehl et al. 2015; Nwammuo and Nwafor 2019; Kamruzzaman et al. 2020). Through extension services which seek to promote information sharing, build capacities, train farmers and livestock keepers, promote climate-smart practices, awareness raising and drive innovation, state and non-state extension agents are doing their best to beef-up agro-based climate adaptation packages around the world (Mahon et al. 2010; Ngwenya and Hagmann 2011; Faure et al. 2012; Leeuwis et al. 2013; Simpson and Burpee 2014; Mahmoudi and Knierim 2015; Neufeldt et al. 2015). This is having a positive impact on the adaptive capacity and resilience of farmers and livestock breeders (Sala et al. 2016; Simpson 2016).

Agricultural systems across Africa are among the most adversely impacted by climate change (FAO 2018; Awazi and Quandt 2021). These agricultural systems which could be categorized into livestock only, sole cropping/monoculture and mixed agricultural systems are already bearing the brunt of climate change induced extreme weather events like droughts, floods, pests and diseases and heat waves (IFAD 2012). In the horn of Africa as well as southern Africa for example, prolong droughts and recurrent pests and diseases (the army worm) have killed thousands of livestock and destroyed vast swaths of cropland, respectively leading to famine and malnutrition (FAO 2020; Aljazeera 2022). Agro-based climate adaptation packages tailored to suit the needs of the most vulnerable populations could help mitigate the adverse impacts of climate change on the agricultural sector if they are properly popularized and adopted by farmers—especially women farmers noted for their reticence in the adoption and implementation of new agricultural technologies.

Sub-Saharan African countries like Cameroon have been severely battered by climate change, with the agricultural sector taking the hit (Molua and Lambi 2002; Molua 2009; Amawa et al. 2015; Kimengsi and Balgah 2015; Balgah et al. 2016; Awazi and Tchamba 2018; Awazi et al. 2019; Mbuli et al. 2021; Tume and Kimengsi 2021)—owing largely to archaic agricultural systems and poor agricultural practices. Sole cropping/monocropping and livestock only systems continue to exist especially in the large agro-industrial estates like the Cameroon Development Corporation (CDC), PAMOL, SOCAPALM, SODECOTON, SOSUCAM, UNVDA, PHP (Plantation du Haut Penja) banana plantation, tea estates in Djuttitsa, Tole and Ndu; as well as the Wakwa cattle ranch in Ngaoundere and the Dumbo cattle ranch in Misaje, northwest region, which makes these estates highly vulnerable to the whims and caprices of a changing climate (Kimengsi and Muluh 2013; Neba et al. 2013; Antu et al. 2016). Poor agricultural practices such as large-scale intensification without regard

for the environment (especially in the market gardening sector), burning before cultivation (rotational bush fallowing and the "Ankara system"), and deforestation for agricultural purposes are only worsening the climate hazard rendering farmers highly vulnerable (Ball 2016). Only a shift from environmentally malign agricultural systems and practices to environmentally benign agricultural systems and practices can help farmers to adapt to and/or mitigate the adversities of climate change (Ball 2016). Extension services are doing their utmost best to introduce and popularize different agro-based climate adaptation packages to farmers and livestock keepers (Julie et al. 2017). These extension agents who can be categorized into state, international and civil society organisations are ramping up agro-based climate adaptation packages in a bid to limit the adverse impacts of climate change on the agricultural sector. The adequate capture of these agro-based climate adaptation packages by farmers (men, women, and male and female youths) is primordial if climate change adaptation is to be effective. However, studies have always shown that gender is a major factor influencing adaptation to climate change (Molua 2011). With the highly patriarchal, cultural and religious norms in sub-Saharan Africa in general and Cameroon in particular, gender has a major role to play in the capture of agro-based climate adaptation packages—with major ramifications for rural transformation and agricultural systems and practices.

The motivation for this study is therefore drawn from the lacuna in literature covering gender dimensions of capture of agro-based climate adaptation packages introduced by state, international and civil society actors. The use of 'capture' here is drawn from the elite capture literature (Lund and Saito-Jensen 2013). Elite capture denotes a situation in which well-placed local actors or organizations tend to monopolize benefits intended for less privileged community members, dominate participation and decision-making processes (Ribot 2004), monopolize benefits and resources (Platteau and Abraham 2002), or misappropriate resources and funds (Platteau and Gaspart 2003; Ribot 2004). In this case, we define gender differentiated capture as a situation in which well-placed male or female actors monopolize resources intended for less privileged members and/or dominate participation and decision-making processes in the frame of climate adaptation interventions. However, the intention in this article is to understand whether it is the men (adult male), women (adult female) or youth (both male and female) who 'capture' agro-based adaptation intervention packages more, and the conditions under which this occurs. Gender plays an important role in shaping the agricultural landscape owing to the differences in gender responsibilities in the domain of agriculture. While men are largely involved in cash crops and livestock rearing, women are mainly involved in food crop farming and marketing of agricultural products which is attributable to gender disparities. Youths (both male and female), are mainly involved in market gardening owing to its short-term nature and quick profits obtained from the sale of the market garden products. Taking as case study the northwest region of Cameroon, this study therefore seeks to shed light on gendered differences in the capture of agro-based climate adaptation packages introduced by state, international and civil society actors, and the implications for agrarian change. More specifically, the study seeks to analyse the typology of agro-based climate adaptation packages; explore gender differences in the capture of agro-based climate adaptation packages; and discuss the extent to which gender-

based differences in the capture of agro-based climate adaptation packages (re)shape agrarian change.

Analytical framework

Figure 1 presents the analytical framework of the study. As seen on the Fig. 1, farmers and livestock keepers in the northwest region of Cameroon are involved in different agricultural systems and practices. The main agricultural systems common in the study area are sole/monocropping, mixed cropping, livestock only systems, mixed farming and agroforestry. These agricultural systems are characterized by different practices including intensive/extensive farming, intensive/extensive livestock rearing, climate-smart/non-climate-smart practices, short and long cycle cropping, organic/inorganic farming, and environmentally benign/environmentally malign practices.

The state, international and civil society actors come in with their extension services and introduce different agro-based climate adaptation packages geared towards helping farmers and livestock keepers adapt to climate change. The packages are categorized into training and capacity building, information dissemination, improved farm inputs, improved livestock breeds, technological support, research and development, and climate-smart agricultural practices. Through different capture mechanisms including dominant information, social networks, group information, and alliance of convenience; farmers and livestock keepers categorized into men (adult male), women (adult female) and youths (both male and female) capture these adaptation packages. The gender differentiated capture of these agro-based climate adaptation packages triggers major changes in agricultural systems and practices with the most common being shifts from sole/monocropping to mixed cropping, mixed farming and agroforestry; shift from livestock only systems to mixed farming; shifts from extensive to intensive farming; shifts from extensive to intensive livestock rearing; change from long cycle to short cycle cropping; shifts from inorganic to more organic farming; shifts from early planting to staggered planting; shifts from environmentally malign to environmentally benign practices; and shifts from non-climate-smart to more climate-smart practices. These goes to show that agro-based climate adaptation packages introduced by state, international and civil society actors have major implications on agricultural systems and practices, and play an important role in climate change adaptation and the enhancement of the livelihood of farmers and livestock keepers.

Materials and methods

Study area

The study was carried out in one of Cameroon's agroecological zones (agroecological zone 3) known as the western highlands. Cameroon has five major agroecological zones (AEZ) i.e. the Sudano-Sahelian zone (AEZ 1), the High Guinea Savannah (AEZ 2), the Western Highlands (AEZ 3), the Monomodal rainforest (AEZ 4) and

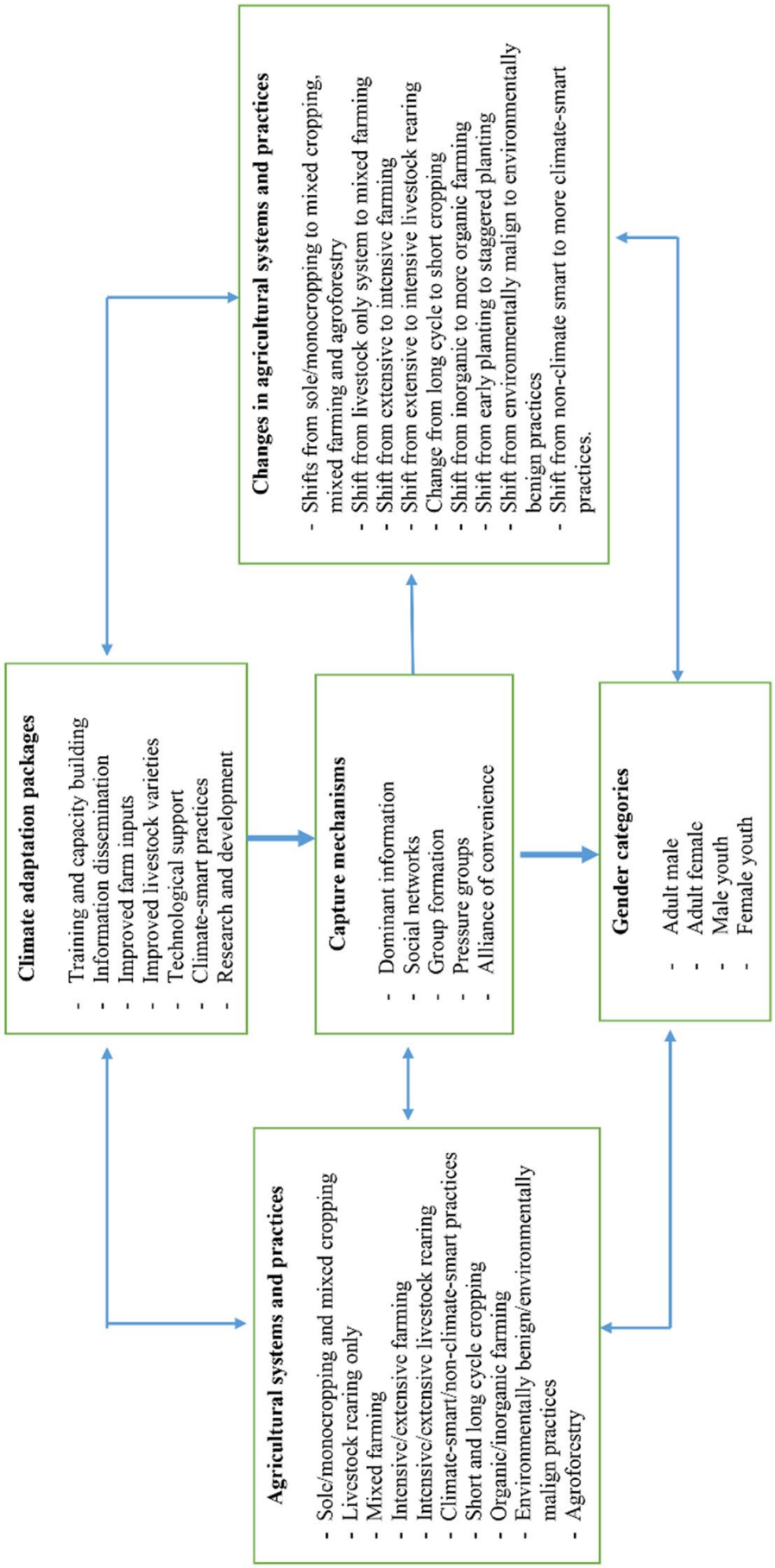

Fig. 1 Analytical framework on gendered capture of agro-based climate adaptation packages and shifts in agricultural systems and practices

the Bimodal rainforest (AEZ 5). The western highlands of Cameroon as the name implies has an undulating topography characterized by hills, plains, plateau, valleys and mountains. The vegetation is dominated by savannah grassland with some patches of Afromontane Forest. Streams and rivers dominate the hydrographical network. The soils are ferralitic, volcanic and alluvial. The climate is the tropical highland type made up of two main seasons i.e., the rainy and dry seasons, with an average temperature of 25 °C. The western highlands cut across two main administrative regions i.e. the northwest and west regions, although it extends into parts of the southwest and littoral regions.

The study sites of this study were in the northwest region i.e., Mezam, Momo and Boyo divisions (Fig. 2). These study sites have the same biophysical characteristics found across the entire western highlands. The three sites constitute 3 of the 7 divisions that make up the northwest region—the other four being Ngoketunjia, Menchum, Donga-Mantung and Bui divisions. Agriculture is the main economic activity practiced by the population living in the three study sites. These agricultural activities are carried out mainly by peasant farmers who own farm plots of less than 5 hectares in most cases. These peasant farmers/agro-pastoralists are involved in the cultivation of food crops (maize, beans, yams, sweet potato, cassava, cocoyams, plantains etc.), cash crops (coffee, banana, oil palms), fruit trees (avocado, mango, plums, guava, oranges) as well as livestock keeping (goats, sheep, pigs, table birds, local fowls, rabbits, guinea pigs) and apiculture.

Sampling and data collection procedures

Sampling was done in different phases. The first phase involved the purposive selection of the northwest region and the three study sites (Momo, Boyo and Mezam divisions) owing to the predominance of peasant farmers and different agro-based climate adaptation interventions. The North West Region forms part of the Western Highlands agro-ecological zone of Cameroon which has been witnessing significant demographic pressure, landscape degradation (Gwan et al. 2022) and the attendant consequences of climate variability and change (Kimengsi and Silberberger 2023). Due to such growing issues, several climate adaptation interventions have been received in this agro-ecological zone with focus on the three selected divisions (Kimengsi et al. 2022). It is for this reason that this study purposively selected this case.

The second phase involved reconnaissance field missions to the study sites to take stock of the realities on the ground and plan the field survey proper. This further informed the design of the data collection instruments and the selection of the specific communities and target respondents. During this phase, key actors in the area of climate adaptation were identified to include state officials, traditional leaders, farming and livestock groups and representatives of state structures which support agro-based climate adaptation. The third phase involved focus group discussions [with mostly farmers and livestock keepers which were made up of women (adult female), men (adult male) and male and female youths] and key informant interviews with traditional leaders, chiefs of agricultural posts, sub-divisional and divisional delegates of agriculture and rural development, heads of common initiative groups (CIGs), heads

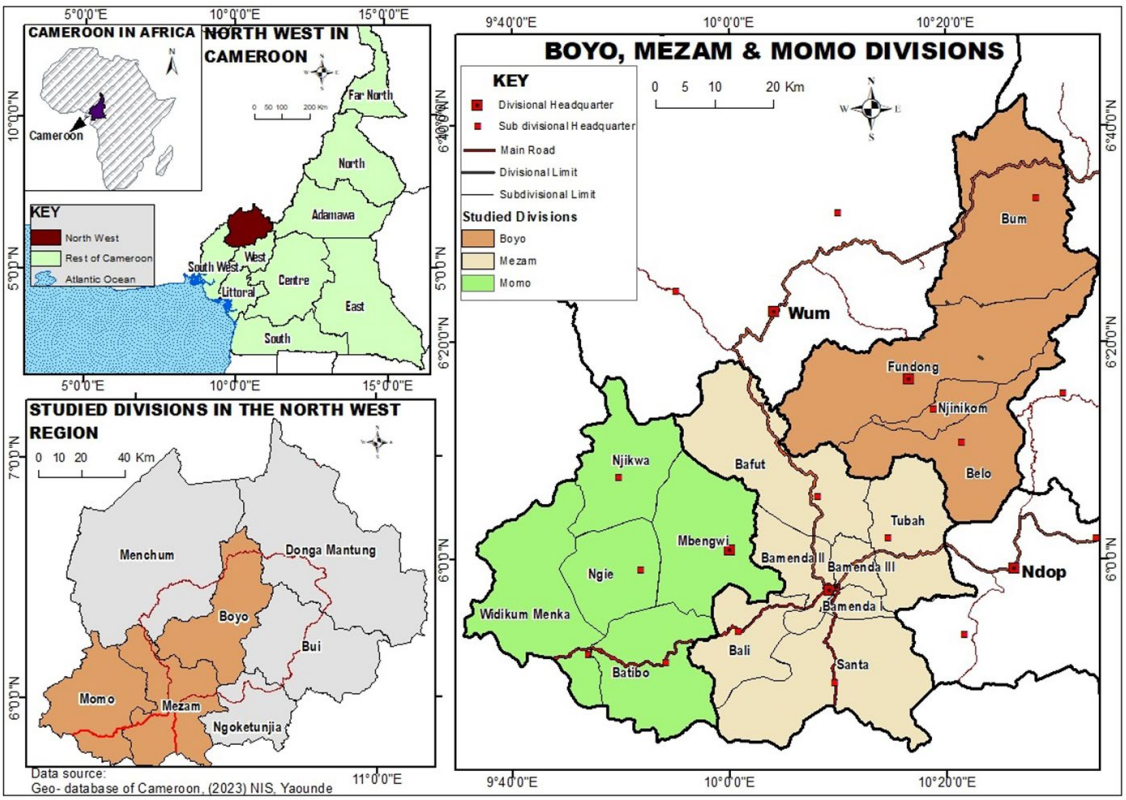

Fig. 2 Map of the study area

of farming groups, heads of farmers' unions, directors of state controlled institutions like ANAFOR, IRAD, regional representatives of international bodies like ICRAF, CIFOR, ACEFA and the world bank. The fourth and last phase involved direct field observations to understand field realities and corroborate information obtained from focus group discussants and key informants. This was done through transect walks across the different communities in Mezam, Boyo and Momo divisions.

Data collection was done through focus group discussions (FGDs) and key informant interviews (KIIs) in communities in the three selected study sites (Table 1). FGDs and KIIs were conducted using interview guides which were designed to respond to the specific research questions of the study which were: what are the types of agro-based climate adaptation packages introduced to farmers? Are there gender differences in the capture of agro-based climate adaptation packages? How does gender-based differences in the capture of agro-based climate adaptation packages (re)shape agrarian change? The interview guides therefore factored in these key questions in the design. A total of 14 focus group discussions were conducted i.e., 5 in Mezam division, 6 in Momo division and 3 in Boyo division (Table 1). Each focus group discussion was made up of 10–15 participants with an equal representation of male and female farmers. The reason for an equal representation of each gender was to avoid bias and a lopsided discussion. The composition of each focus group included farmers, livestock keepers, persons from the civil society, representatives of NGOs, government officials etc. However, a majority of the participants were farmers and livestock keepers. For key informant interviews, a total of 89 were conducted i.e., 30 in Mezam, 39 in Momo and 20 in Boyo (Table 1). Key informants surveyed were traditional leaders, heads of farming groups and farming unions, heads of CIGs,

Table 1 Number of key informant interviews and focus group discussions conducted in the study sites

Division	Community/village	Number of key informant interviews	Number of focus group discussions
Mezam	Mankon Nkwen Bambui Bambili Kedjom-Keku Mendakwe Mbei-Santa Akum Njong-Santa Awing	30 (11 adult male, 10 adult female, 4 male youth, and 5 female youth)	5 (each focus group discussion had 10–15 participants with equal representation of men, women and youths)
Momo	Ku-Bome Ngyen-Mbo Njah-Etu Tugi Bessi Formukong Funam Nyen Kai Njimetu	39 (13 adult male, 14 adult female, 6 male youth, and 6 female youth)	6 (each focus group discussion had 10–15 participants with equal representation of men, women and youths)
Boyo	Njinikejim Acha Baingo I Mbingo II Kitchu	20 (7 adult male, 7 adult female, 3 male youth and 3 female youth)	3 (each focus group discussion had 10–15 participants with equal representation of men, women and youths)
Total	24	89	14

NGOs and government officials etc. The consent of key informants and focus group discussants were sought before interviews.

Data analysis

The content and theme-based approach was used to analyse the qualitative data obtained from key informant interviews and focus group discussions. A manual in-depth content analysis was done owing to the relatively small number of key informant interviews (n = 89; 31 adult male, 31 adult female, 13 male youth and 14 female youth) and focus group discussions (n = 14; each focus group discussion had 10–15 participants with equal representation of the male and female folk). Thus, the manual method sufficed for a rigorous analysis of the data collected.

Results and discussion

Actors and typology of agro-based climate adaptation packages introduced to farmers and livestock breeders

Extension services provide a plethora of agro-based climate adaptation packages to farmers and livestock keepers. These extension services are categorized into state, international and civil society based. State-based extension services were the most dominant. The main state actors involved in extension services included the Ministry of Forestry and Wildlife (MINFOF) and its decentralized services (regional, divisional and sub-divisional delegations of forestry and wildlife as well as forestry posts in communities and villages); the National Agency for Forestry Development (ANAFOR); the Ministry of Agriculture and Rural Development (MINADER) and its decentralized services (regional, divisional and sub-divisional delegations of agriculture and rural development as well as agricultural posts in different communities/villages) as well as programmes such as the Programme for the Improvement of Competitiveness of Family Agro-pastoral Farms (ACEFA), the National Program for Agricultural Extension and Research (PNVRA), and the Chamber of Agriculture, Fisheries, Livestock and Forest (CAPEF); the Ministry of Environment, Protection of Nature and Sustainable Development (MINEPDED) and its decentralized services (regional, divisional and sub-divisional delegations of MINEPDED); the Ministry of Livestock, Fisheries and Animal Husbandry (MINEPIA) and its decentralized services (regional, divisional and sub-divisional delegations of MINEPIA) as well as programmes like the Programme for the Consolidation and Sustainability of Agro-pastoral Counselling (PCP-ACEFA) and the Support Programme for the Renovation and Development of Vocational Training in the Agriculture, Livestock and Fisheries Sectors, Consolidation and Sustainability Phase (PCP-AFOP); the Ministry of Scientific Research and Innovation (MINRESI) and its decentralized services like the Institute of Agricultural Research for Development (IRAD), the Ministry of Youth Affairs and Civic Education (MINJEC) through programmes/projects like the National Support Programme for Rural and Urban Youths (PAJER-U), the Ministry of Employment and Vocational Training (MINEFOP) and its decentralized services, the Northwest Development Authority (MIDENO), State run higher education and research institutions like the University of Bamenda, Regional College of Agriculture (RCA) and Technical School of Agriculture (TSA), Bambili; state owned media like La Société de Presse et d'Éditions du Cameroun (SOPECAM) and the Cameroon Radio Television (CRTV). For crop-based agrarian systems, the extension services of state-based actors are involved in introducing and vulgarizing agro-based climate adaptation packages like hybrid crop varieties (disease and drought resistant), irrigation technologies (furrow, drip and sprinkler), agroecological farming practices like agroforestry, environmentally friendly fertilizers and pesticides, training and capacity building, and regular climate information dissemination. For livestock-based agrarian systems, these state-based actors have introduced and popularized packages such as hybrid livestock species (disease resistant), training and capacity building, and dissemination of weather information.

Anecdotes of farmers and livestock keepers show that state-based extension services are playing a major role towards enhancing adaptation through a series of agro-based adaptation packages.

In Santa sub-division, a key informant noted that:

> *Projects/programmes under the tutelage of MINADER like ACEFA are playing a major role in helping farmers and livestock keepers through the provision of varied agro-based adaptation packages like improved potato seedlings, hybrid tomato varieties, and hybrid livestock varieties especially pigs and table birds. These improved crop and livestock varieties are resistant to pests and diseases, and helps farmers to withstand the adversities of climate change.*

In Mankon, an expert informant noted that:

> *MIDENO is a major driver of agricultural transformation faced with the adversities of climate change. Through the provision of improved crop varieties and farm equipment to farmers especially tractors and caterpillars for tilling of the soil and opening of farm-to-market roads, farmers who are part of cooperatives and CIGs are able to cultivate vast portions of land with ease and obtain better yields which goes to improve their living standards, thereby reducing poverty.*

Focus group discussants in Tubah sub-division confirmed that, MINRESI through its decentralized services like IRAD has helped them a lot through different agro-based climate adaptation packages. According to them:

> *IRAD in general and IRAD Bambui in particular has been supplying us with improved seedlings of maize, beans, cassava, cocoyams, potato, legumes, vegetables, coffee, fruit trees, as well as improved farming technologies like improved fallows, which has contributed towards improving yields and reducing poverty. IRAD Bambui has equally been supplying us with improved livestock and fishery varieties which are highly productive. All these have made us more resilient, improving our adaptive capacity faced with recurrent extreme weather events.*

Moreover, an expert informant in Santa affirmed that:

> *The project known as PAJER-U under the tutelage of MINJEC has played a vital role in helping youths (both male and female) adapt to climate change through the provision of different agro-based adaptation packages. The project provides youths with financial assistance that helps them to set up modern food and cash crop farms. Some youths have equally used the financial support provided by the PAJER-U project to engage themselves in intensive market gardening crop cultivation while others have gone into intensive livestock farming (pig rearing and poultry).*

In Cameroon, state actors are the primary providers of extension services to farmers and livestock breeders which is reflected in studies carried out by Nyambi et al. (2016) Fongang et al. (2017), Julie et al. (2017) Tambi (2018), Amungwa (2018) Forchu (2019), Forbang et al. (2019). This scenario is however contrary to what obtains in other countries in Africa (Abegaz and Wims 2015; Ozor and Cynthia 2011; Mustapha et al. 2012; Faure et al. 2013; Mkisi 2014; Afful 2016), Asia (Islam et al. 2011; Chowdhury et al. 2014; Iqbal and Jagdish 2018; Aryal et al. 2019; Won et al. 2019) and across Latin America (Hellin et al. 2014; Landini 2015, 2016) where it was found that non-state actors are those mainly involved in the provision of extension services to farmers and livestock keepers.

The main international actors involved in extension services geared towards improving agro-based climate adaptation packages include the World Agroforestry Centre (ICRAF), the Centre for International Forestry Research (CIFOR), the German Agency for International Cooperation (GIZ), Plan International, HELVETAS Swiss Intercooperation, Heifer Project International (HPI), the Netherlands Development Organization (SNV), INADES Formation Cameroon, Service d'Appui aux Initiatives Locales de Développement (SAILD), International Fund for Agricultural Development (IFAD), African Development Bank (AfDB), Consultative Group for International Agricultural Research (CGIAR), International Potato Centre (CIP), International Cooperation Centre of Agricultural Research for Development (CIRAD), World Bank, the French Development Agency (AFD) through the C_2D AFOP project to assist rural youths, Global Forum for Rural Advisory Services (GFRAS), International Institute of Tropical Agriculture (IITA). These international actors contribute towards introducing and vulgarizing packages like improved varieties of crops and livestock, sensitization, training and capacity building, technology transfer, and research and development.

International actors and the extension services they provide are critical for the dissemination of agro-based climate adaptation packages. This is confirmed by key and expert informants as well as focus group discussants. In Belo sub-division, an expert informant noted that:

> *ICRAF is helping farmers enormously to adapt to climate change through the supply of different climate adaptation packages like improved varieties of fruit trees like plums, avocado, mango, oranges, guava (for integration in their farms) as well as organizing educational and sensitization workshops on new agroforestry technologies like improved fallows which help to improve soil fertility and crop productivity.*

In Santa, focus group discussants affirmed that:

> *The International Potato Centre and the International Institute for Tropical Agriculture are helping us enormously through the provision of improved varieties of potato which are suitable for the climatic conditions of Santa. These hybrid potato varieties are equally very resistant to pest and diseases, and can withstand extreme weather events.*

International actors are also playing a major role in the dissemination of innovations geared towards improving the livelihoods of farmers and livestock keepers. Studies carried out across the world—most especially in the developing world (World Bank 2006, 2012; UNDP 2010; Guei et al. 2011; Degrande et al. 2012; Fongang et al. 2017; Sulaiman 2017; Sulaiman et al. 2018), have shown that international organizations like the Food and Agricultural Organization of the United Nations (FAO), the United Nations Development Programme (UNDP), the World Agroforestry Centre (ICRAF), the French Development Agency (AFD) and the world bank are doing their best to popularize innovations through the provision of extensions services to farmers and livestock breeders.

Civil society actors involved in extension services with a goal to improving agro-based climate adaptation packages included local NGOs like the Twantoh Mixed Farming Common Initiative Group (MIFACIG), Strategic Humanitarian Services (SHUMAS), Sustainable Run for Development (SURUDEV), Farming Education Programme (FEPCIG), Society for Initiatives in Rural Development and Environmental Protection (SIRDEP), Sustainable Livestock Foundation (SLF), Cameroon Gender and Environment Watch (CAMGEW); Cooperatives like the Northwest Cooperative Association Limited (NWCA), Mbengwi Cooperative Credit Union Ltd (MBECCUL), Njindom Cooperative Credit Union Ltd (NJICCUL), North West Pig Farmers' Cooperative (Nowepifac); farmers' unions like the Mbengwi farmers' union (MBEFU), Santa farmers' union, North West Farmers' Organization (NOWEFOR); Periodicals such as the Farmer's Voice, The Ecologist published by SURUDEV; Community and denominational radio stations like Rainbow radio station in Mbengwi, Santa community radio, Foundation radio, Radio Evangellum, Cameroon Baptist Convention (CBC) radio, Christian Broadcasting Service (CBS); Private radio stations like Abakwa FM, Afrique Nouvelle, Ndefcam radio, Radio Hot Cocoa; private and denominational higher education and research institutions like the Bamenda University of Science and Technology (BUST), the Catholic University Bamenda and the Pan African Institute for Development-West Africa (PAID-WA, Bamenda); livestock keepers unions like pig farmers' union, poultry farmers' union; graziers' unions like the Mbengwi graziers union, Santa graziers' union; common initiative groups like Njah-Etu farmers common initiative group in Mbengwi, Mbei farmers common initiative group in Santa; loan and thrift groups (Njangi) like "Trouble Bank" in Mbengwi; faith-based associations like the Mbororo Socio-Cultural and Development Association (MBOSCUDA), Catholic Men's Association (CMA), Catholic Women's Association (CWA), Christian Men's Fellowship (CMF), Christian Women's Fellowship (CWF), Christian Youth Fellowship (CYF), Men's, Women and Youth Fellowship in the Baptist church; village development associations like Mbei Cultural and Development Association (MBECUDA), Metta Cultural and Development Association (MECUDA), Bome Area Development Association (BADA), Santa Village Development and Cultural Association (SAVIDECA), Alatening Cultural and Development Association (ACDA), Nkwen Cultural and Development Association (NCDA), Mankon Cultural and Development Association (MACUDA), Mankon Youths Cultural and Development Association (MAYOCUDA), Ndong Awing Cultural and Development Association (NACDA), Bambui Cultural and Development Asssociation (BACUDA), Bamendakwe Development and Cultural

Association (BAMEDCA), Belo Area Development Union (BADU), Kedjom Keku Cultural and Development Association (KEKUDA); Northwest Bee-farming Association (NOWEBA). These civil societies are mainly involved in the vulgarization of adaptation packages like hybrid varieties, financial assistance, sensitization, training and capacity building as well as peer-to-peer information sharing.

Civil societies are omnipresent in the northwest region of Cameroon and they continue to play a vital role towards advancing agro-based climate adaptation packages in the rural agrarian milieu. Key informants, experts and focus group discussants attested to this. In Nkwen, a key informant affirmed that:

> *SHUMAS has trained me on how to cultivate crops and raise livestock using different modern techniques. This has enabled me to set up my own farms and raise different types of livestock including pigs, goats and table birds. Today, I am independent and financially stable thanks to the training I received from SHUMAS. I encourage my fellow farmers and livestock rearers to go to SHUMAS for more training as this will build their capacity and enable them to practice modern farming techniques that will better adapt to climate change.*

In Boyo division, focus group discussants in Njinikejim stated that:

> *We are able to adapt to the adversities of climate change thanks to the modern agricultural practices introduced by MIFACIG. MIFACIG is providing us with improved fruit trees like mango, avocado, orange, guava and plum; better flowering trees for apiculture; and regular sensitization and training on ways of adapting to climate change. The introduction of modern farming systems like improved fallows with shrub species like Tephrosia vogelii, Calliandra calothyrsus is also helping us to improve soil fertility and increase crop yields faced with climate change adversities.*

In Mankon, focus group discussants affirmed that:

> *Public, private, denominational and community radio stations and magazines/newspapers/periodicals are helping us to adapt to climate change through regular information updates on environmental issues. Every farming season, radio stations and newspapers/magazines inform us about the onset of the rainy season and caution us on when to plant our crops. This information is very helpful to us as it has made it possible for us to stagger our planting dates in order to match the onset of rains. This has also prevented low crop productivity and crop failure.*

In Mbengwi, an expert informant noted that:

> *Village cultural and development associations like BADA and MECUDA are playing an important role in aiding farmers and livestock keepers adapt to climate change. These associations provide farmers and livestock keepers with financial support, provide logistics like farm tools and irrigation equipment as*

well as resolve conflicts over common resources between farmers and livestock rearers. All these go to assist the adaptation efforts of farmers and livestock keepers.

Civil societies have been noted to play a vital role in agricultural extension by different studies. In Cameroon, the studies of Fongang et al. (2020) showed that radio stations (community, denominational, private and public radio stations) play a vital role in rendering agricultural extension services in the west region of Cameroon. Similarly, studies carried out in Mozambique (Chapota 2015), Malawi (Chapota et al. 2014) and across different parts of the developing world (Perkins et al. 2015; Rao 2015) found that radio stations play a crucial role in the provision of extension services to farmers and livestock keepers. Other studies carried out in Cameroon have shown that the civil society under the banner of community/grassroots organizations (Degrande et al. 2012; Essougong et al. 2018), Farmers' groups/organizations (Guei et al. 2011; Tsafack et al. 2014), common initiative groups—CIGs and local non-governmental organizations (Kuissu et al. 2021), private agro-enterprises like the Cameroon Development Corporation—CDC and the Cameroon Cotton Corporation—SODECOTON (Balarabé et al. 2008; Amungwa 2009) and smallholder seed enterprises (Guei et al. 2011) are playing a major role in the dissemination of innovations geared towards improving the lot of farmers and livestock breeders. Although these studies showed that civil societies played an important role in the provision of extension services to farmers and livestock keepers, little or no emphasis was laid on the adaptation packages introduced by these civil societies to aid farmers and livestock keepers mitigate the adversities of climate change. This study therefore sought to fill this research gap.

Gender-based differences in the capture of agro-based climate adaptation packages

There were significant differences in the capture of agro-based climate adaptation packages between men (adult male), women (adult female) and male and female youths. Going by Cartwright and Nancarrow (2022), gender refers to the socially constructed characteristics attributed to men (adult male), women (adult female) and male and female youths. We therefore adopt this analytical approach in the reporting of the results.

Women (adult female) mostly captured state-introduced agro-based climate adaptation packages like hybrid crop species, hybrid livestock varieties (especially table birds), organic manure and environmentally friendly fertilizers which could be attributed to the fact that women are mainly interested in ensuring food self-sufficiency in households and improving household income. Thus, women prefer short term activities that provide quick returns than activities that take a longer time to provide returns.

In Santa, a woman (adult female) farmer noted that:

My main objective is to feed my children and family which explains why I cultivate mainly food crops. In recent years I have been planting hybrid varieties

of maize and potato because of the changing environmental conditions which makes it difficult for me to cultivate and have a good harvest like before. These hybrid varieties are introduced by government agencies like the delegations of agriculture and rural development as well as IRAD.

This was affirmed by another woman farmer in Bambui who stated that:

I have been planting hybrid varieties of maize, cassava, beans cocoyams and sweet potato provided by IRAD Bambui. These varieties are high yielding and produce within a short period of time, and they withstand harsh weather conditions like prolong dryness. As food has become very expensive in the market, farmers like myself need these hybrid varieties in order to produce enough food for our families.

Male youths on their part equally captured agro-based mainly agro-based climate adaptation packages introduced by the state like hybrid crop varieties, hybrid livestock varieties (especially pigs and table birds), and different irrigation practice like sprinkler, drip and furrow—especially for those involved in market gardening crop cultivation, as well as environmentally friendly fertilizers and pesticides. Male youths (who range in age between 18 and 25 years), are generally impatient and so go for packages that provide quick returns like hybrid market gardening crop varieties (potato, tomato, cabbage, carrots) and hybrid livestock (like the Neima pig variety and fast-growing varieties of table birds)—that provide returns with a maximum of nine months. Female youths for example were mainly involved in the cultivation of market gardening crops like Leeks, Cabbage, Carrots as well as *Solanum potato*. Youths (especially female youths) equally captured environmentally fertilizers and pesticides like those of the YARA Company which increase productivity and fight pest and diseases.

An expert informant in Mankon stated that:

Youths (both male and female) of today as not as patient as the youths of old. In our days we were very patient and we were involved in the activities that took a long time to yield returns like the planting of coffee and oil palms. Youths of today are different as they go for activities that provide immediate or short-term benefits like market gardening or poultry farming. Government and NGO agents usually come around to popularize modern practices that can improve the livelihood resilience of the farming population, but youths will only be interested in practices that yield quick returns like poultry farming, pig rearing or market gardening crops. Very few youths are interested in practices that yield long term benefits like coffee planting, oil palm cultivation or the planting of fruit trees.

Youths (male and female) who are persons in the age bracket 18 to 25 years play an important role in the domain of agriculture and their integration in this study as part of gender is due to the neglect of youth in scientific and policy discourse although they constitute the largest proportion of the population.

Men on their part were more holistic in their capture of agro-based climate adaptation packages as they captured the different packages introduced and popularized by the state, international bodies and the civil society. Men therefore captured agro-based climate adaptation packages like hybrid crop varieties, irrigation technologies, agroecological farming practices like agroforestry, environmentally friendly fertilizers and pesticides, training and capacity building, climate information dissemination as well as hybrid livestock species. This therefore increased the adaptive capacity of men and male youths when compared to female youths and women (adult female). The holistic capture of agro-based climate adaptation packages by men could be attributed to their more open-minded nature, coupled to the fact that men are more educated than their women counterparts. It could also be attributed to the fact that men own most of the livelihood assets (especially financial, physical and natural assets) which gives them more leverage to adopt and implement these packages. Moreover, patriarchal, customary and religious practices place men at an advantageous position when it comes to decision making at the household level, which makes it easier for men to capture agro-based climate adaptation packages than their women counterparts.

During a focus group discussion in Mbengwi, men asserted that:

> *The state, the civil society and international bodies have introduced different packages to help us adapt in the face of climate change adversities. We the men have adopted most of these best practices especially hybrid varieties of crops and animals, agroforestry, fertilizers and pesticides, improved fruit tree species as well as training and capacity building workshops; and it has helped us a lot to adapt to frequent extreme weather events like reduced quantity of rainfall, extreme sunshine, rising temperatures.*

Although this study clearly shows gender differences in the capture of agro-based climate adaptation packages introduced by state and non-state actors, limited research has been done in other parts of the world to ascertain this. Most studies focused on gender differences in adaptation and adaptation choices faced with climate change. For instance Molua (2011), in a study carried out in Cameroon uncovered the existence of differences in climate change adaptation options between men and women. In the same light, studies carried out across Africa, Asia and the developing world in general (UNDP 2010; USAID 2013; Carr and Thompson 2014; Jin et al. 2015; Mersha and Van Laerhoven 2016; Mishra and Pede 2017; Ngigi et al. 2017; Jerneck 2018; Lawson et al. 2020) revealed major gender differences in the adaptation response of farmers and livestock keepers faced with climate change adversities. With very limited literature on the capture of agro-based climate adaptation packages, this study is therefore timely as it has filled this research gap and added more flesh to existing literature.

The mechanisms of capture of agro-based climate adaptation packages by male and female youths, women and men were mainly through the formation of different types of groups and associations like farmers' associations, apiculture associations, livestock keepers' associations, market gardeners' associations, village/community associations, common initiative groups, youth-only associations, men-only associa-

tions, women-only associations as well as loan and thrift associations (Njangi groups). These different associations lobbied the state, as well as international and civil society extension services for better agro-based climate adaptation packages, which are distributed among members. In Santa found in Mezam division of the northwest region, a key informant noted that, "We have different associations which make it easier for us to receive support from state organizations as well as international NGOs which goes to benefit all the members belonging to the association". Other mechanisms of capture of agro-based climate adaptation packages included dominant information, social networks, group information and alliance of convenience.

Gender-based differences in the capture of agro-based climate adaptation packages and implications on agricultural systems and practices

There were different agricultural systems and practices taken up by farmers and livestock keepers. The main agricultural systems included crop only agricultural systems (sole cropping/monocropping), mixed cropping systems, livestock rearing only systems, mixed farming systems (simultaneous cultivation of crops and rearing of livestock), and agroforestry-based agricultural systems. These main agricultural systems were characterized by different practices like intensive and extensive crop cultivation practices, intensive and extensive livestock rearing practices, long and short duration cropping, climate-smart and non-climate smart practices, organic and inorganic farming practices, staggering of planting dates, environmentally friendly and non-environmentally friendly practices.

Gender-based differences in the capture of agro-based climate adaptation packages significantly (re)shaped agricultural systems and practices. There have been major changes in agricultural systems and practices with the most common being shifts from sole/monocropping to mixed cropping, mixed farming and agroforestry; shift from livestock only systems to mixed farming; shifts from extensive to intensive farming; shifts from extensive to intensive livestock rearing; change from long cycle to short cycle cropping; shifts from inorganic to more organic farming; shifts from early planting to staggered planting; shifts from environmentally malign to environmentally benign practices; and shifts from non-climate-smart to more climate-smart practices. With a large proportion of women and female youths as well as some men capturing state-introduced packages like hybrid crop varieties, hybrid livestock varieties and irrigation technologies, there has been a shift from local and extensive farming systems to more modern and intensive farming systems. Improvements in irrigation technologies through the use of sprinkler, furrow and drip irrigation has led to the cultivation of crops (especially market gardening crops like tomato, carrots, cabbage, potato, celery, lettuce, cucumber, huckleberry, etc.) all year round, rather than just the rainy season. The capture of hybrid crop varieties and application of environmentally friendly fertilizers and pesticides has induced a shift from extensive farming practices like rotational bush fallowing and shifting cultivation to more intensive farming systems involving the cultivation of small plots of land to obtain higher yields. It has also reduced the level of pollution and damage to the environment resulting from wildfires set up in the course of rotational bush fallowing. The introduction of hybrid livestock varieties has induced more intensive

livestock rearing practices like paddocking, ranching and creation of poultries and modern pigsties reducing the need for nomadic and free-range rearing of livestock. More intensive livestock rearing has increased the income of livestock keepers and reduced farmer-livestock breeder conflicts which are very common in the northwest region of Cameroon.

Although most studies have not directly focused on gender dimensions of capture of agro-based climate adaptation packages, some studies like those of Speranza et al. (2009) Sheokand and Singh (2012) Joto Afrika (2013), Elia (2013), Ogunbameru et al. (2013), Wamalwa et al. (2016), Wekesa et al. (2018), Bedeke et al. (2019), Naab et al. (2019), Nwammuo and Nwafor (2019) Antwi-Agyei and Stringer (2021), have shown that state and non-state actors are involved in the provision of extension services to farmers and livestock keepers—mostly inhabiting rural areas. In Mbengwi, a key informant asserted that:

> *Men are able to capture all the introduced packages than women and youths because they are the undisputed heads of families and make all the decisions, and because they are the ones who own most of the land.*

Meanwhile in Santa, a women farmer stated that:

> *It is very difficult for me and most women farmers to adopt some best practices like agroforestry and planting of fruit trees introduced by governmental and non-governmental agencies because I don't have enough land. Mostly men own the land and if I plant a tree, I won't be able to reap the benefits from planting the tree because I can't own the tree.*

The large-scale capture by men of agro-based climate adaptation packages introduced and popularized by international agencies and civil societies like agroecological farming systems (agroforestry and other tree and organic based farming systems), training and capacity building, information dissemination (especially weather/climate information) as well as research and development has completely transformed the rural agrarian landscape. Agroforestry and other tree-based farming systems have contributed towards making the agrarian landscape greener while providing different ecosystem services (food, fuelwood, building materials, water, windbreaks, soil fertility improvement, and flowers for bee keeping) which aid farmers' adaptation efforts. Training and capacity building as well as information dissemination has improved the know-how of male farmers and livestock keepers in particular making them more conscious of the environmental change occurring around them and the remedial measures to take to counter adverse environmental hazards. Thus, most male farmers are staggering their planting dates to march the onset of rains. Farmers and livestock keepers are equally making more use of their local knowledge to adapt to the changing environment.

Few studies have actually addressed gendered differences in the capture of agro-based climate adaptation packages and implications on agrarian change (Mangheni et al. 2019), which clearly shows a dearth of knowledge on gender-based capture of adaptation packages in the face of climate change. This could be attributed to dif-

ferent barriers including administrative bottlenecks and policy flaws which limit the capacity of extension services to reach out to farmers and livestock keepers (Fongang et al. 2017; Forbang et al. 2019; Lasram et al. 2021). Although few studies have demonstrated the role played by gender in the capture of agro-based climate adaptation packages, some studies have shown that extension services through capacity building, training, introduction of climate-smart practices, information dissemination, agricultural innovation systems, climate advisory services, agricultural advisory services; awareness raising campaigns play a major role in rural agrarian transformation and livelihood improvement of farmers and livestock breeders (Stål and Bonnedahl 2015; Morton-Wright et al. 2016; Sulaiman 2017; Sulaiman et al. 2018). Overall, the capture of different agro-based climate adaptation packages has enabled some farmers and livestock keepers (male and female youths, men and women) to adapt to the adverse effects of climate change thereby reducing environmental migration, rural-urban exodus, food insecurity and poverty.

Conclusion and policy implications

The existential threat posed by climate change is today well established. Agrarian systems are already bearing the brunt of the environmental catastrophes triggered by climate change—including floods, droughts, wildfires, storms, hurricanes, typhoons and heat waves. This calls for a ramping up of adaptation measures geared towards countering the adversities imposed by climate change. Studies have shown that state, international and civil society actors introduce and popularize a plethora of agro-based climate adaptation packages to help farmers adapt to climate change. However, limited research has been carried out focusing on the gender dimension of capture of these agro-based climate adaptation packages and the implications they have on agrarian change. This study was therefore carried out to fill this gap in knowledge and build on exiting literature. Our key findings were that: agro-based climate adaptation packages are mainly introduced and popularized by the state, international actors and civil society organizations; women (adult female) and female youth farmers and livestock keepers capture mainly agro-based climate adaptation packages introduced by the state while men (adult male) and male youth farmers and livestock keepers are more general in their capture of agro-based climate adaptation packages i.e. capturing adaptation packages introduced by the state, international actors and civil society organizations. The mechanism of capture of adaptation packages by men (adult male), women (adult female) and male and female youth farmers and livestock keepers is mainly through the formation of groups/associations to lobby for the interests of the different associations/groups. The capture of different agro-based climate adaptation packages had major implications for agrarian change in the crop-based and livestock keeping sectors with the most common being shifts from sole/monocropping to mixed cropping, mixed farming and agroforestry; shift from livestock only systems to mixed farming; shifts from extensive to intensive farming; shifts from extensive to intensive livestock rearing; change from long cycle to short cycle cropping; shifts from inorganic to more organic farming; shifts from early planting to staggered planting; shifts from environmentally malign to environmentally benign practices; and shifts from non-climate-smart to more

climate-smart practices. Improvement of irrigation techniques has led to more market gardening with different crops like tomato, cabbage, condiments and vegetables being grown on a large scale all year round. Equally, the use of hybrid crop species, application of environmentally friendly fertilizer and pesticides has led to a shift from local and extensive farming practices like shifting cultivation and rotational bush fallowing to more intensive cropping systems. Equally the introduction of hybrid livestock species has led to more intensive livestock practices like paddocking and ranching, thereby reducing the need for livestock keepers to remain nomadic. Thus, the two main agrarian systems (crop and livestock based) have witnessed major shifts owing to the capture of different agro-based climate adaptation practices by men, women and youths. Gender-based differences in the capture of agro-based adaptation packages could be attributed to patriarchy, poor land tenure systems, educational and income disparities and archaic cultural and religious practices. Policy makers need to craft and implement policies which encourage women (adult female) and female youth farmers to adopt not just state introduced agro-based climate adaptation packages but all the other agro-based climate adaptation packages introduced by international actors and civil society organizations.

Acknowledgements The authors are immensely thankful to the farmers, key informants and focus group discussants who willfully consented to take part in this study for the vital information they provided which enabled us to present the credible findings found in this paper. We are equally thankful to the reviewers and editor(s) for the pertinent comments they proffered which enabled us to improve on the quality of the paper.

Author contributions Conceptualization: N.P.A, and J.N.K.; Original Draft preparation: N.P.A., J.N.K. and G.W.F.; Introduction and Methodology review and editing: N.P.A.; Presentation of Results and Discussion of Findings: N.P.A., J.N.K. and G.W.F. All authors read and agreed to the published version of the manuscript.

Funding Open Access funding enabled and organized by Projekt DEAL.

Data availability The dataset used for this study is available upon reasonable request from the corresponding author.

Code availability Not applicable.

Declarations

Informed consent All farmers, key informants and focus group discussants consented willfully to take part in the study and the information collected from them has been treated with utmost anonymity to ensure their privacy.

Conflict of interest The authors declare no conflict of interest.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit http://creativecommons.org/licenses/by/4.0/.

References

Abegaz DM, Wims P (2015) Extension agents' awareness of climate change in Ethiopia. J Agric Educ Extension 21(5):479–495. https://doi.org/10.1080/1389224X.2014.946936

Afful DB (2016) Public extension agents' need for new competencies: evidence from a climate variability study in Limpopo province, South Africa. S Afr J Agric Ext 44(2):59–70. https://doi.org/10.17159/2413-3221/2016/v44n2a387

Aljazeera (2022) Drought crisis puts horn of Africa 'on the brink of catastrophe'. News report February 15, 2022. https://www.aljazeera.com/economy/2022/2/15/on-the-brink-of-catastrophe-horn-of-africa-in-drought-crisis

Amawa AS, Kimengsi JN, Sunjo TE, Awambeng AE (2015) The implications of climate variability on market gardening in Santa sub-division, north-west region of Cameroon. Environ Nat Resour Res 5(2):14–23. https://doi.org/10.15580/GJEMPS.2015.1.031114142

Amungwa FA (2009) Appraisal of privatization of agricultural extension services in Cameroon. J Agric Ext Rural Dev 1(3):085–092. https://doi.org/10.5897/JAERD.9000012

Amungwa FA (2018) Appraisal of innovations in agricultural extension and advisory services in Cameroon. J Advan Plant Sci 1(2):204. http://article.scholarena.com/Appraisal-of-Innovations-in-Agricultural-Extension-and-Advisory-Services-in-Cameroon.pdf

Antu NV, Nkwemoh CA, Tchawa P (2016) The vulnerability of swamp rice production to the observed effects of rainfall and temperature variability in Ndop sub-division, Cameroon. Canadian Journal of Tropical geography/Revue Canadienne de Géographie Tropicale 3(2):01–15. https://www3.laurentian.ca/rcgt-cjtg/wp-content/uploads/2017/01/Article_1_Nkiene-V.Antu_vol_3_2_2016.pdf

Antwi-Agyei P, Stringer LC (2021) Improving the effectiveness of agricultural extension services in supporting farmers to adapt to climate change: insights from northeastern Ghana. Clim Risk Manage 32(2021):100304. https://doi.org/10.1016/j.crm.2021.100304

Aryal K, Thapa PS, Lamichhane D (2019) Revisiting agroforestry for building climate resilient communities: a case of package-based integrated agroforestry practices in Nepal. Emerg Sci J 3(5):303–311. https://doi.org/10.28991/esj-2019-01193

Awazi NP, Tchamba NM (2018) Determinants of small-scale farmers' adaptation decision to climate variability and change in the north-west region of Cameroon. Afr J Agric Res 13(12):534–543. https://doi.org/10.5897/AJAR2018.12971

Awazi NP, Quandt A (2021) Livelihood resilience to environmental changes in areas of Kenya and Cameroon: a comparative analysis. Clim Change 165(2021):33. https://doi.org/10.1007/s10584-021-03073-5

Awazi NP, Tchamba NM, Avana TML (2019) Climate change resiliency choices of small-scale farmers in Cameroon: determinants and policy implications. J Environ Manage 250(2019):109560. https://doi.org/10.1016/j.jenvman.2019.109560

Balarabé O, Abba AA, Olivier D, Naudin K (2008). Structured or spontaneous dissemination of DMC techniques in small-scale cotton-based agriculture? The northern Cameroon cases. Regional workshop on conservation agriculture, Laos 2008, pp 10. https://agritrop.cirad.fr/560166/1/document_560166.pdf

Balgah RA, Kimengsi JN, Buchenrieder G (2016) Understanding and building on indigenous agro-pastoral adaptation strategies for climate change in Sub-Saharan Africa: experiences from Rural Cameroon. J Adv Agric 6(1):833–840

Ball A (2016) The future of agriculture in Cameroon in the age of agricultural biotechnology. Independent Study Project (ISP) Collection 2287. https://digitalcollections.sit.edu/isp_collection/2287

Bedeke S, Vanhove W, Gezahegn M, Natarajan K, Van Damme P (2019) Adoption of climate change adaptation strategies by maize-dependent smallholders in Ethiopia. NJAS Wageningen J Life Sci 88:96–104. https://doi.org/10.1016/j.njas.2018.09.001

Carr ER, Thompson MC (2014) Gender and climate change adaptation in Agrarian settings: current thinking, new directions, and research frontiers. Geogr Compass 8(3):182–197. https://doi.org/10.1111/gec3.12121

Cartwright T, Nancarrow C (2022) A question of gender: gender classification in international research. Int J Market Res 64(5):575–593. https://doi.org/10.1177/14707853221108663

Chapota R (2015) Rapid assessment on the use of radio in extension and advisory services in Mozambique. Report produced as part of the United States Agency for International Development (USAID) project "Modernizing Extension and Advisory Services" (MEAS), p 41. https://agrilinks.org/sites/default/files/resource/files/MEAS%20Radio%20Mozambique%20Report%20Feb%202015.pdf

Chapota R, Fatch P, Mthinda C (2014) The role of radio in agricultural extension and advisory services: experiences from Malawi. MEAS case study#8, February 2014, p 11. https://farmradio.org/wp-content/uploads/2020/09/MEAS-CS-Malawi-Farm-Radio-Chapota-Fatch-Mthinda-Feb-2014-1.pdf

Chikaire J, Nnadi FN, Orusha JO, Nwoye EO, Onogu B (2011) The role of agricultural extension in climate change adaptation and mitigation in agriculture. World Rural Obs 3(4):1–8. https://www.sciencepub.net/rural/rural0304/01_6288rural0304_1_8bak1.pdf

Chowdhury AH, Odame HH, Leeuwis C (2014) Transforming the roles of a public extension agency to strengthen innovation: lessons from the national agricultural extension project in Bangladesh. J Agric Educ Extension 20(1):7–25. https://doi.org/10.1080/1389224X.2013.803990

Christoplos I (2010) Mobilizing the potential of rural and agricultural extension. Retrieved from Food and Agriculture Organization of the United Nations website: http://www.fao.org/3/i1444e/i1444e00.htm

Degrande A, Franzel S, Yeptiep YS, Asaah EK, Tsobeng A, Tchoundjeu Z (2012) Effectiveness of grassroots organisations in the dissemination of agroforestry innovations. In: Kaonga ML (ed) Agroforestry for biodiversity and ecosystem services -science and practice. InTech, pp 141–164. https://doi.org/10.5772/33283

Diehl DC, Galindo-Gonzalez S, Dourte DR, Sloan NL, Bartels WL, Furman C, Fraisse CW (2015) Toward engagement in climate training: findings from interviews with agricultural extension professionals. J Rural Social Sci 30(1):25–50. https://egrove.olemiss.edu/jrss/vol30/iss1/3

Elia EF (2013) Information dissemination for adaptation to climate change and variability in the agriculture sector: the case of Maluga and Chibelela Villages, Central Tanzania. Ph.D thesis, University of KwaZulu-Natal, Pietermaritzburg, South Africa, pp. 430. https://ukzn-dspace.ukzn.ac.za/bitstream/handle/10413/10814/Elia_Emmanuel_Frank_2013.pdf?sequence=1andisAllowed=y

Essougong UPK, Fongang GHF, Degrande A (2018) Can community-based organisations deliver adequate agricultural information to farmers? Evidence from rural resources centres in Cameroon. Inf Dev. https://doi.org/10.1177/0266666918754937

FAO (2020). The global action for fall armyworm control: action framework 2020–2022. Working together to tame the global threat– Rome. https://doi.org/10.4060/ca9252en

FAO, IFAD, UNICEF, WFP, WHO (2018) The state of food security and nutrition in the world 2018. Building climate resilience for food security and nutrition. Rome, FAO. Licence: CC BY-NC-SA 3.0 IGO. https://www.fao.org/3/i9553en/i9553en.pdf

Faure G, Desjeux Y, Gasselin P (2012) New challenges in agricultural advisory services from a research perspective: a literature review, synthesis and research agenda. J Agric Educ Extension 18(5):461–492. https://doi.org/10.1080/1389224X.2012.707063

Faure G, Penot E, Rakotondravelo JC, Ramahatoraka HA, Dugué P, Toillier A (2013) Which advisory system to support innovation in conservation agriculture? The case of Madagascar's Lake Alaotra. J Agric Educ Extension 19(3):257–270. https://doi.org/10.1080/1389224X.2013.782169

Fongang FG, Feujeo KG, Melachio NM (2020) Role of radio in agricultural advisory service in western region of Cameroon. Int J Agric Ext 7(3):197–206. https://doi.org/10.33687/ijae.007.03.2300

Fongang GHF, Watio MS, Havard M (2017) Approaches, effects and challenges of agricultural advisory services experienced by the program for the improvement of the competitiveness of family agro-pastoral farms (ACEFA) in Dja-et-Lobo Division (Cameroon). Asian J Agric Ext Econ Sociol 18(4):1–11. https://doi.org/10.9734/AJAEES/2017/35039

Forbang LE, Amungwa F, Lengha TN (2019) Famers' perceptions on effectiveness of extension delivery approaches to Mbororo women livestock farmers in North-West Region Cameroon. J Agric Ext Rural Dev 11(3):48–55. https://doi.org/10.5897/JAERD2018.1027

Forchu NT (2019) Linking smallholder farmers to markets: the role of extension in market information distribution for poverty reduction in Fako, Cameroon. MSc thesis, Iowa State University Ames, Iowa 2019, https://www.proquest.com/openview/e712a8bb62cb9d28976ec3c0d6f4837e/1?pq-origsite=gscholarandcbl=18750anddiss=y

Guei RG, Barra A, Silué D (2011) Promoting smallholder seed enterprises: quality seed production of rice, maize, sorghum and millet in Northern Cameroon. Int J Agric Sustainability 9(1):91–99. https://doi.org/10.3763/ijas.2010.0573

Gwan SA, Kimengsi JN, Fogwe ZN (2022) Landscape degradation processes and implications in the south eastern part of the Western highlands of Cameroon. Int J Environ Climate Change 11(12):525–535. https://doi.org/10.9734/ijecc/2021/v11i1230606

Hellin J, Bellon MR, Hearne SJ (2014) Maize Landraces and adaptation to climate change in Mexico. J Crop Improv 28(4):484–501. https://doi.org/10.1080/15427528.2014.921800

IFAD (2012) Independent Office of Evaluation, Republic of Ghana. IFAD Report No. 2433–GH. Accra: IFAD.

IPCC (2018) Summary for policymakers. In: Masson-Delmotte V, Zhai P, Pörtner HO, Roberts D, Skea J, Shukla PR, …, Waterfield T. (eds) Global warming of 1.5 °C: An IPCC special report on the impacts of global warming of 1.5 °C, World Meteorological Organization, Geneva

Iqbal S, Jagdish G (2018) Role of extension agencies in climate change related adaptation strategies. Int J Farm Sci 3(1):143–155. https://www.indianjournals.com/ijor.aspx?target=ijor:ijfsandvolume=3andissue=1andarticle=020andtype=pdf

Islam MM, Gray D, Reid J, Kemp P (2011) Developing sustainable farmer-led extension groups: lessons from a Bangladeshi case study. J Agric Educ Extension 17(5):425–443. https://doi.org/10.1080/1389224X.2011.596658

Jerneck A (2018) Taking gender seriously in climate change adaptation and sustainability science research: views from feminist debates and sub-Saharan small-scale agriculture. Sustain Sci 13(2018):403–416. https://doi.org/10.1007/s11625-017-0464-y

Jin J, Wang X, Gao Y (2015) Gender differences in farmers' responses to climate change adaptation in Yongqiao District, China. Sci Total Environ 538(2015):942–948. https://doi.org/10.1016/j.scitotenv.2015.07.027

Joto Afrika (2013) Adapting to climate change in Africa. Special Issue, Issue 12, June 2013, pp 8. https://www.careclimatechange.org/wp-content/uploads/2015/05/JotoAfrika12_FINAL.pdf

Julie DT, Amungwa FA, Manu I (2017) Role of agricultural extension in climate change adaptation in Cameroon. Int J Horticulture Agric Food Sci (IJHAF) 1(3):21–26. https://doi.org/10.22161/ijhaf.1.3.5

Kamruzzaman M, Daniell KA, Chowdhury A, Crimp S, James H (2020) How can agricultural extension and rural advisory services support innovation to adapt to climate change in the agriculture sector? Adv Agric Dev 1(1):48–62. https://doi.org/10.37433/aad.v1i1.9

Kimengsi JN, Silberberger M (2023) How endogenous cultural institutions may (not) shape peasant farmers' climate adaptation practices: learning from Rural Cameroon. Soc Nat Resour. https://doi.org/10.1080/08941920.2023.2175283

Kimengsi JN, Akumbo CM, Balgah RA, Tingum EN, Tume SJP, Gwan SA (2022) Farm-based climate adaptation dynamics: insights from the vegetable sector in the Western highlands of Cameroon. Cogent Soc Sci 8(1):2126452. https://doi.org/10.1080/23311886.2022.2126452

Kimengsi JN, Muluh NG (2013) A comparative assessment of the effect of climatic variations on the crops of the Cameroon development corporation (CDC): adaptation options. Environ Nat Resour Res 3(1):144–156. https://doi.org/10.5539/enrr.v3n1p144

Kimengsi JN, Balgah RA (2015) Building an indigenous agro-pastoral adaptation framework to climate change in Sub-Saharan Africa: experiences from the north-west region of Cameroon. Procedia Environ Sci 29:126–127. https://doi.org/10.1016/j.proenv.2015.07.214

Kuissu FGM, Fongang GHF, Bikomo RM (2021) Advisory and extension services related to the supply of agricultural inputs in Cameroon: the case of the Mifi and Menoua divisions. Asian J Agric Ext Econ Sociol 39(5):86–100. https://doi.org/10.9734/ajaees/2021/v39i530580

Landini F (2015) Different Argentine rural extensionists' mindsets and their practical implications. J Agric Educ Extension 21(3):219–234. https://doi.org/10.1080/1389224X.2014.927375

Landini F (2016) Unfolding the knowledge and power dynamics of the 'farmers–rural extensionists' interface in north-eastern Argentina. J Agric Educ Extension 22(5):399–413. https://doi.org/10.1080/1389224X.2016.1227050

Lasram A, Dellagi H, Dessalegn B, Dhehibi B, Mechlia NB (2021) Assessing institutional barriers to effective dissemination strategies of proven water management practices to face climate change threats in the citrus growing area in Tunisia. In: Khebour Allouche F, M A-H, Negm AM (eds) Agriculture productivity in Tunisia under stressed environment. Springer Water, Springer, Cham. https://doi.org/10.1007/978-3-030-74660-5_10

Lawson ET, Alare RS, Salifu ARZ et al (2020) Dealing with climate change in semi-arid Ghana: understanding intersectional perceptions and adaptation strategies of women farmers. Geo J 85:439–452. https://doi.org/10.1007/s10708-019-09974-4

Leeuwis C, Hall A, van Weperen W, Preissing J (2013) Facing the challenges of climate change and food security: the role of research, extension and communication for development. Retrieved from Food and Agriculture Organization of the United Nations website: http://www.fao.org/3/a-i3334e.pdf

Lund JF, Saito-Jensen M (2013) Revisiting the issue of elite capture of participatory initiatives. World Dev 46:104–112. https://doi.org/10.1016/j.worlddev.2013.01.028

Mahmoudi H, Knierim A (2015) Risk communication for farmers' adaptation to climate change: a new task for agricultural advisory services. Int J Performab Eng 11(6):533–547. Retrieved from: https://doi.org/10.23940/ijpe.15.6.p533.mag

Mahon M, Farrell M, McDonagh J (2010) Power, positionality and the view from within: agricultural advisers' roles in implementing participatory extension programmes in the Republic of Ireland. Sociologia Ruralis 50(2):104–120. https://doi.org/10.1111/j.1467-9523.2010.00505.x

Mangheni MN, Tufan HA, Nkengla L, Aman BO, Boonabaana B (2019) Gender norms, technology access, and women farmers' vulnerability to climate change in Sub-Saharan Africa. In: Bamutaze Y, Kyamanywa S, Singh B, Nabanoga G, Lal R (eds) Agriculture and ecosystem resilience in Sub Saharan Africa. Climate change management. Springer, Cham. https://doi.org/10.1007/978-3-030-12974-3_32

Mbuli CS, Fonjong LN, Fletcher AJ (2021) Climate change and small farmers' vulnerability to food insecurity in Cameroon. Sustainability 13(3):1523. https://doi.org/10.3390/su13031523

Mersha AA, Van Laerhoven FA (2016) Gender approach to understanding the differentiated impact of barriers to adaptation: responses to climate change in rural Ethiopia. Reg Environ Change 16:1701–1713. https://doi.org/10.1007/s10113-015-0921-z

Mishra AK, Pede VO (2017) Perception of climate change and adaptation strategies in Vietnam: are there intra-household gender differences? Int J Clim Change Strateg Manag 9(4):501–516. https://doi.org/10.1108/IJCCSM-01-2017-0014

Mkisi RB (2014) The role of agricultural extension in smallholder farmer adaptation to climate change in Blantyre District, Malawi. Open Access Theses. 353. Purdue University, pp. 113. https://docs.lib.purdue.edu/open_access_theses/353

Molua E, Lambi C (2002) Climate variability, vulnerability and effectiveness of farm-level adaptation options: the challenges and implications for food security in Southwestern Cameroon. Environment and Development Economics 7:529–545. Cambridge University Press. http://nersp.nerdc.ufl.edu/~vecy/LitSurvey/Molua.pdf

Molua EL (2009) An empirical assessment of the impact of climate change on smallholder agriculture in Cameroon. Global Planet Change 67(3-4):205–208. https://doi.org/10.1016/j.gloplacha.2009.02.006

Molua EL (2011) Farm income, gender differentials and climate risk in Cameroon: typology of male and women adaptation options across agroecologies. Sustain Sci 6(2011):21–35. https://doi.org/10.1007/s11625-010-0123-z

Morton-Wright L, Prokopy LS, Arbuckle JJG, Ingels C, Thelen M, Bellm R, Bowman D, Edwards L, Ellis C, Higgins R, Higgins T, Hudgins D, Hoorman R, Neufelder J, Overstreet B, Peltier A, Schmitz H, Voit J, Wegehaupt C, Wohnoutka S, Wolkowski R, Abendroth L, Angel J, Haigh T, Hart C, Klink J, Knutson C, Power R, Todey D, Widhalm M (2016) Climate change and agricultural extension; building capacity for land grant extension services to address the agricultural impacts of climate change and the adaptive management needs of agricultural stakeholders. Technical report series: findings and recommendations of the climate and corn-based cropping systems coordinated agricultural project. Vol 3 of 5. CSCAP Publication no. CSCAP-0192-2016. https://sustainablecorn.org/PDF_download.php/doc/Tech-Report_Vol-3_Ext.pdf

Mustapha S, Undiandeye U, Gwary M (2012) The role of extension in agricultural adaptation to climate change in the Sahelian zone of Nigeria. J Environ Earth Sci 2(6):48–58. Retrieved from https://core.ac.uk/download/pdf/234662958.pdf

Naab FZ, Abubakari Z, Ahmed A (2019) The role of climate services in agricultural productivity in Ghana: the perspectives of farmers and institutions. Clim Serv 13(2019):24–32. https://doi.org/10.1016/j.cliser.2019.01.007

Neba AG, Ndonwi AS, Mimba A (2013) Impacts of climate variability and change on Banana yields in the CDC- Delmonte Banana project, Tiko, South West Region, Cameroon. J Cameroon Acad Sci 11(2 and 3):131–142. https://www.ajol.info/index.php/jcas/article/view/102478

Neufeldt H, Negra C, Hancock J, Foster K, Nayak D, Singh P (2015) Scaling up climate-smart agriculture: lessons learned from South Asia and pathways for success. Retrieved from World Agroforestry Centre website: http://www.worldagroforestry.org/downloads/Publications/PDFS/WP15720.pdf

Ngigi MW, Mueller U, Birner R (2017) Gender differences in climate change adaptation strategies and participation in group-based approaches: an intra-household analysis from Rural Kenya. Ecol Econ 138(2017):99–108. https://doi.org/10.1016/j.ecolecon.2017.03.019

Ngwenya H, Hagmann J (2011) Making innovation systems work in practice: experiences in integrating innovation, social learning and knowledge in innovation platforms. Knowl Manag Dev J 7(1):109–124. https://doi.org/10.1080/19474199.2011.593867

Nwammuo AN, Nwafor GU (2019) Evaluation of level of awareness and information diffusion of climate change adaptation strategies among farmers. Int J Inform Technol Comput 5(1):11–22. https://www.researchgate.net/publication/337946036_Evaluation_of_Level_of_Awareness_and_Information_Diffusion_of_Climate_Change_Adaptation_Strategies_among_Farmers

Nyambi GN, Shinn GC, Briers GE (2016) Factors that influence extension program success: what can we learn from Cameroon extension? Int J Agric Ext 4(3):149–158. https://www.academia.edu/96726582/International_Journal_of_Agricultural_Extension_FACTORS_THAT_INFLUENCE_EXTENSION_PROGRAM_SUCCESS_WHAT_CAN_WE_LEARN_FROM_CAMEROON_EXTENSION_A_B_S_T_R_A_C_T?uc-sb-sw=63779971

Ogunbameru BO, Mustapha SB, Idrisa YL (2013) Capacity building for climate change adaptation: modules for agricultural extension curriculum development in Nigeria. Span J Rural Dev 4(1):75–79. https://www.researchgate.net/publication/286261002_CAPACITY_BUILDING_FOR_CLIMATE_CHANGE_ADAPTATION_MODULES_FOR_AGRICULTURAL_EXTENSION_CURRICULUM_DEVELOPMENT/fulltext/57c60b8008ae424fb2cf87ed/CAPACITY-BUILDING-FOR-CLIMATE-CHANGE-ADAPTATION-MODULES-FOR-AGRICULTURAL-EXTENSION-CURRICULUM-DEVELOPMENT.pdf

Ozor N, Cynthia N (2011) The role of extension in agricultural adaptation to climate change in Enugu state, Nigeria. J Agric Ext Rural Dev 3(3):42–50. Retrieved from http://www.academicjournals.org/app/webroot/article/article1379426712_Ozor%20and%20Nnaji.pdf

Perkins K, Huggins-Rao S, Hansen J, Van Mossel J, Weighton L, Lynagh S (2015) Interactive radio's promising role in climate information services. Farm radio international concept paper. CCAFS working paper no. 156. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark. Available online at: www.ccafs.cgiar.org p 31.

Platteau JP, Gaspart F (2003) The risk of resource misappropriation in community-driven development. World Dev 31(10):1687–1703. https://doi.org/10.1016/S0305-750X(03)00138-4

Platteau JP, Abraham A (2002) Participatory development in the process of endogenous community imperfections. J Dev Stud 39(2):104–136. https://doi.org/10.1080/00220380412331322771

Rao S (2015) Using radio in agricultural extension. Note 18. GFRAS good practice notes for extension and advisory services. GFRAS, Lindau, Switzerland, p 4. https://farmradio.org/wp-content/uploads/2020/09/GFRAS-GGP-Note18_Using-Radio-in-Agricultural-Extension-1.pdf

Ribot JC (2004) Waiting for democracy: the politics of choice in natural resource decentralization. World Resources Institute, Washington. http://pdf.wri.org/wait_for_democracy.pdf

Sala S, Rossi F, David S (2016) Supporting agricultural extension towards climate-smart agriculture: an overview of existing tools. Compendium climate-smart agriculture and extension. Retrieved from Food and Agriculture Organization of the United Nations website: http://www.fao.org/3/a-bl361e.pdf

Sheokand RN, Singh S (2012) ICT based agro-informatics for precision and climate resilient agriculture. Proceedings of agro-informatics and precision agriculture (AIPA) 2012, INDIA, pp 64–68. https://scholar.google.com/citations?view_op=view_citationandhl=enanduser=alXvwsAAAAAJandcitation_for_view=alXvwsAAAAAJ:d1gkVwhDpl0C

Simpson BM (2016) Pocket guide 1: extension practice for agricultural adaptation. Preparing smallholder farm families to adapt to climate change. Retrieved from: https://www.crs.org/sites/default/files/tools-research/pocket-guide-1.pdf

Simpson BM, Burpee CG (2014) Adaptation under the "new normal" of climate change: the future of agricultural extension and advisory services. Modernizing extension and advisory services (MEAS) discussion paper, 2014, pp. 29. https://meas.illinois.edu/wp-content/uploads/2015/04/Simpson-Burpee-2014-Climate-Change-and-EAS-MEAS-Discussion-Paper.pdf

Speranza IC, Kiteme B, Opondo M (2009) Adapting public agricultural extension services to climate change: insights from Kenya (Unpublished). In: Amsterdam conference on the human dimensions of global environmental change. Amsterdam, Netherlands. 02.12.-04.12.2009.

Stål HI, Bonnedahl KJ (2015) Provision of climate advice as a mechanism for environmental governance in Swedish agriculture. Environ Policy Gov 25(5):356–371. https://doi.org/10.1002/eet.1677

Sulaiman RV (2017) Enabling advisory services for climate-smart agriculture: key elements to foster farmers' adoption of CSA practices. Policy brief enabling advisory services for CSA. Retrieved from Food and Agriculture Organization of the United Nations website: http://www.fao.org/3/a-bs940e.pdf

Sulaiman RV, Chuluunbaatar D, Vishnu S (2018) Upscaling climate smart agriculture: lessons for extension and advisory services. Retrieved from Food and Agriculture Organization of the United Nations website: http://www.fao.org/uploads/media/Climate_Smart_Agriculture_draft08.pdf

Tambi MD (2018) Cassava production and extension service delivery in Cameroon. J Agric Sci Study 1(1):1–9. http://jass.jarap.org/published/vol1issue1/68d84.pdf

Tsafack S, Degrande A, Franzel S, Simpson B (2014) Farmer-to-farmer extension in Cameroon: a survey of extension organizations. ICRAF working paper no. 182. Nairobi, World Agroforestry Centre. DOI: https://doi.org/10.5716/WP14383.PDF

Tume SJP, Kimengsi JN (2021) Indigenous and modern agro-based climate adaptation practices in rural Cameroon. Int J Environ Stud 79(6):1057–1066. https://doi.org/10.1080/00207233.2021.1977538

UNDP (2010) Gender, climate change and community-based adaptation. UNDP, New York. https://www.undp.org/sites/g/files/zskgke326/files/publications/Gender%20Climate%20Change%20and%20Community%20Based%20Adaptation%20(2).pdf

USAID (2013) Gender and climate change in Agrarian settings. Global Climate Change Office, Climate Change Resilient Development Project, Washington, DC, p 64. https://www.climatelinks.org/sites/default/files/asset/document/Gender.Climate.Change.Agrarian.Settings.pdf

Wamalwa IW, Mburu BK, Mang'uriu DG (2016) Agro climate and weather information dissemination and its influence on adoption of climate smart practices among small scale farmers of Kisii County, Kenya. J Biol Agri Healthcare 6(10):14–23. https://core.ac.uk/reader/234662000

Wekesa BM, Ayuya OI, Lagat JK (2018) Effect of climate-smart agricultural practices on household food security in smallholder production systems: micro-level evidence from Kenya. Agric Food Secur 7(2018):80. https://doi.org/10.1186/s40066-018-0230-0

Won J, Babu SC, Rana A (2019) Building a climate change-resilient food system in Korea: the case of extension and technology dissemination services. IFPRI discussion paper 01861, pp. 46. https://www.ifpri.org/publication/building-climate-change-resilient-food-system-korea-case-extension-and-technology

World Bank (2006) Enhancing agricultural innovation: how to go beyond the strengthening of research systems. Retrieved from http://documents.worldbank.org/curated/en/864351468325269468/pdf/379000Enhancin101OFFICIAL0USE0ONLY1.pdf

World Bank (2012) Agricultural innovation systems: an investment sourcebook. Retrieved from https://openknowledge.worldbank.org/handle/10986/2247

Authors and Affiliations

Nyong Princely Awazi[1,2] · Jude Ndzifon Kimengsi[3,4] · Gadinga Walter Forje[5]

✉ Jude Ndzifon Kimengsi
jude_ndzifon.kimengsi@tu-dresden.de; kimengsi.jude@uniba.cm

Nyong Princely Awazi
nyongprincely@gmail.com; awazinyong@uniba.cm; pnyong@fokabs.com

Gadinga Walter Forje
gwforje@gmail.com

1 Department of Forestry and Wildlife Technology, College of Technology, The University of Bamenda, Bamenda, Cameroon

2 FOKABS INC, 2500 St. Laurent Blvd, Ottawa, ON K1H 1B1, Canada

3 Forest Institutions and International Development (FIID) Research Group, Chair of Tropical and International Forestry, Faculty of Environmental Sciences, Technische Universität Dresden, Dresden, Germany

4 Department of Geography, The University of Bamenda, Bamenda, Cameroon

5 Department of Forestry, Faculty of Agronomy and Agricultural Sciences, University of Dschang, P.O. Box 222-Dschang, Dschang, Cameroon