SURVEY REPORT

Current situation and capacity building needs of extension networks in Vietnam under the context of climate change

October 2023

This survey is a component of the project "**An innovative capacity building mechanism for extension workers and farmers in the context of climate change**" [CBA2021-10SY-Hoang] funded by Asia-Pacific Network for Global Change Research and implemented by Hi-tech Agriculture and Forestry R&D Center.

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LIST OF ABBREVIATIONS

CC	Climate change
CCA	Climate change adaptation
NMR	Northern mountainous region

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ACKNOWLEDGEMENTS

We would like to express our sincere gratitude to the Asia-Pacific Network for Global Change Research (APN) for funding this survey. We would also like to express our sincere thanks to government officials, agricultural extension leaders and workers in Thai Nguyen and Bac Kan provinces who participated in this survey by providing their support and valuable insights for this study.

EXECUTIVE SUMMARY

Under the increasing adverse impacts of climate change, farmers are facing more and more difficulties in their farming. While agricultural extension service has been playing a vital role in supporting smallholder farmers in improving food production and addressing challenges in agricultural production for many decades, in the context of climate change, it is crucial that extension service can continue to effectively helping farmers to overcome challenges.

High rate of poor, near-poor households and the heavy reliance on natural resource for livelihood has made the northern mountainous region (NMR) of Vietnam highly susceptible to increasing adverse impacts of climate change. However, there have been relatively few studies on capacity of agricultural extension workers under the context of climate change in Vietnam in general and in the NMR in particular. Thus, this survey was conducted to determine difficulties, current capacity and training demand of agricultural extension workers in NMR of Vietnam under the impact of climate change. Findings from this survey can be used as a rationale for policy-making and identification of interventions to improve capacity of the local agricultural extension system under the context of changing environment. Main findings of this study are presented below:

Current capacity:

- Generally speaking, the agricultural extension staff are relatively well-educated and experienced. The majority of them are under 35 years old and have more than 5 years of professional experience. Most of the workers hold university degrees in agricultural majors.
- Regarding information and/or learning channels about climate change, the collected data showed that newspaper, radio/television and the internet are main sources.
- Approximately one third of the respondents rated themselves as having poor and very poor understanding about climate change, including causes, adverse impacts, mitigation measures, and adaptation measures in agricultural production.
- More than half of the extension workers (58.1%) had participated in extension activities related to climate change adaptation (CCA) such as dissemination, training and transfer of agricultural techniques. The proportion of workers having no experience in CCA was relatively high at 41.9%.
- Up to 59% of the interviewed extension workers was trained on agricultural extension methods, while only 35.2% of them was trained on CCA in agriculture.
- Their knowledge and skills related to self-study and extension activities are generally rated above average while their competencies related to CCA were rated with lower scores.

Challenges: The main difficulties/challenges that agricultural extension workers in the region encountered due to climate change include:

- Challenging travels for farm visits and other extension activities;
- Development and implementation of agricultural production plans;
- Forecasting and monitoring pests and diseases on plants and animals;

- Increased workload as an indirect result of climate change;
- Dissemination of new technologies to farmers sometimes cannot keep up with changes of production conditions;
- Lack of climate-smart production manuals and not many CCA models have been built for local learning and replication;
- It is more difficult for extension workers to motivate farmers to invest in agricultural production (e.g. adopt new/advanced technologies).

Other difficulties include heavy workload, inadequate on-going training, weak organizational structure, low salary and inadequate resources for extension activities (e.g. human resource, finance and information).

Capacity building demand: The main learning resources that the agricultural extension workers would like to be equipped to effectively carry out their professional tasks under the context of climate change include:

- Climate-smart production manuals (for crops and domestic animals);
- Networking and shared learning (for documents, knowledge and experience sharing among extension workers within and outside their provinces);
- Effective extension communication and/or community outreach methods.

Recommendations for building capacity of the agricultural extension workforce in the context of climate change:

- Extension workers should be adequately provided with information on climate change and CCA techniques in agriculture; established network for shared learning; systems to provide forecasts on weather and occurrence of pests and diseases in an accurate and timely manner.
- For long-term capacity building: Training programs at universities should be more practical, theories should be coupled with practice; There should be studies on CCA tailored to each locality, and; Each locality should have a new-technology testing area for agricultural extension workers to do field trials before disseminating climate-resilient technologies to farmers.
- Other recommendations include: Salary and allowances for agricultural extension workers should be improved to boost their dedication to their professional work; In addition to professional knowledge and skills, agricultural extension workers should also be to be equipped with market knowledge and soft skills; Localities in remote areas, scattered areas, areas that are difficult to approach should be equipped with information dissemination systems such as speakers and radios to receive information timely; It is necessary to restructure agricultural extension agencies from provincial level to commune level to improve synergies and coordination within the agricultural extension system.

1. INTRODUCTION

Climate change has induced increasing challenges in many parts of the world affecting human health, ecosystems, forests, food security and the livelihoods of climate vulnerable communities. There has been strong evidence that agriculture, forestry, fisheries and aquaculture are negatively affected by climate change impacts. Over the past 5 decades, the growth of agricultural productivity has been hindered by human-induced global warming (IPCC 2022).

Vietnam is one of the most vulnerable countries to climate change in Asia and the Pacific Region due to its geographic location, diverse topography and climates together with a long coastline. For many years, plenty of attention on climate change impacts and adaptation strategies was given to the country, especially coastal and delta areas. In contrast, the northern mountainous region (NMR) has received little attention (Care International in Vietnam 2013).

The NMR covers an area of around 95.000 square kilometer, approximately one third of Vietnam's area, and was home to about 12.9 million people in which about 54% belonged to ethnic minority groups (GSO 2019; 2020). In 2018, the proportion of poor and near-poor households in this region was 25.5% and 13.6% respectively. The rate was relatively high compared to the country's average which was 5.23% and 4.95%, respectively (GSO 2020). By 2022, employment in natural-resource-dependent sector (agriculture, forestry and aquaculture) of the region was reported at 42.7% (GSO 2022). High rate of poor, near-poor households and the heavy reliance on natural resource for livelihood has made the region highly susceptible to increasing adverse impacts of climate change.

Extension services have been playing a vital role in supporting smallholder farmers in improving food production and addressing challenges in agricultural production for many decades. Under the increasing adverse impacts of climate change, farmers are facing more and more difficulties in their farming. Thus, it is crucial that extension service can continue to effectively helping farmers in the new context (FAO 2023; Antwi-Ageyi & Stringer 2021; Meera et al. 2012). Care International in Vietnam (2013) reported that in NMR of Vietnam, lack of farmer participation and engagement in planning (such as timing and training content) could result in patchy support and inappropriateness of extension services. This issue had strong connection with capacity of extension service providers and could be of highly concern under climate change impact. However, there have been relatively few studies on current capacity, difficulties and training demand of extension workers in assisting farmer in managing climate-induced impacts in NMR of Vietnam.

Thus, this survey is conducted to determine difficulties, current capacity and training demand of agricultural extension workers in NMR of Vietnam under the impact of climate change. Findings from the survey would provide evidence-based rationale for relevant stakeholders in policy-making, determining intervention, etc. to improve capacity of agricultural extension system in climate change adaptation (CCA).

2. METHODOLOGY

2.1. Study area

2.1.1. Thai Nguyen province

Thai Nguyen is a province adjacent to Hanoi to the North. The province is identified as one of the centers of the Northern midland and mountainous region. The province has 3 cities and 6 districts with 178 communes, wards and towns. Thai Nguyen's population (by 2021) is about 1.3 million people, in which, ethnic minorities (Tay, Nung, San Diu, Mong, San Chay, Dao, Hoa etc.) account for nearly 30% (Thai Nguyen Portal, 2021).

The climate of the province is divided into 4 distinct seasons Spring - Summer - Autumn – Winter. The average annual sunshine duration ranges from 1,300 to 1,750 hours and the average annual precipitation ranges between 2,000 - 2,500 mm. The natural land area of Thai Nguyen is over 3,500 km^2 (Thai Nguyen Portal, 2021). In general, Thai Nguyen has an advantageous climate for agricultural and forestry development. Main crops and plants of Thai Nguyen province are rice, tea and maize. The province also has crops and plants that its localities are famous for such as longan, pomelo, custard apple, guava, etc. Main domestic animals are pigs, chickens, buffaloes, cows, etc.

However, a survey conducted in 2019-2020 revealed that local farmers are very vulnerable to the impact of climate change. Reduced crop/livestock productivity and crop failure were stated by 60.9% and reduced production land and number of crops per year were stated by 44.6% of interviewed farmers.

2.1.2. Bac Kan province

Bac Kan is a mountainous province located in the inland center of Northeast Vietnam. The province has 1 city and 7 districts with 108 communes, wards, and towns. The province has 88% of the population being ethnic minorities such as Tay, Nung, Dao, Mong, San Chay, etc. (Bac Kan Portal, 2020). According to the results of reviewing poor and near-poor households in 2021 according to the multi-dimensional poverty standard applied for the period 2016 - 2020 of the Ministry of Labor - Invalids and Social Affairs, Bac Kan province has 13,867 poor households, accounting for 17.02% and 8,239 near-poor households, accounting for 10.11% (MOLISA, 2022). The rate of poor and near-poor households in the province is 7.7 times and 3.3 times higher than the national average, respectively. According to the announcement of the General Statistics Office, by the end of 2021, Bac Kan province has more than 75% of the population living in rural areas. In addition, the province has a high proportion of workers working in the agricultural sector, with the goal of reducing this proportion to 65% by 2025 (Bac Kan PPC, 2021).

The natural land area of Bac Kan is 485,996 ha, in which agricultural land accounts for about 9%, forest land accounts for about 85.05%. The land is relatively fertile, in many places the soil layer is thick, the hilly soil has high level of humus, suitable for agriculture, forestry, industrial crops, fruit trees, etc. (Bac Kan Portal, 2020). Main crops of Bac Kan province are rice and maize. The province also has crops and plants that its localities are famous for such as seedless persimmons, edible canna, citrus, fragrant squash, apricot and plum, etc. Main domestic livestock includes pigs, poultry, buffaloes, cows, etc.

In the period from 2008 to 2018, the average annual temperature of Bac Kan province increased by 0.8^0C compared to 48 years ago. The total annual rainfall during this period also had an unusual increase and decrease over the years. Extreme weather phenomena such as storms, flash floods, landslides, soil erosion in mountainous areas, and droughts occur more frequently and unusually in the province. Since 2016, heat waves have appeared earlier in the year, heat waves have become more intense and longer lasting with common highest temperatures ranging from 38 – 40^{o}C. In particular, unseasonal heavy rains appear more often in January and March, causing unseasonal floods. Winter is warmer because the average monthly temperature is 1 – 2^{o}C higher than the average for many years, but the difference in day and night temperatures is very large. At night and early in the morning, freezing rain and frost appear more often. The above changes in weather have caused great damage to local agricultural production (Bac Kan PPC, 2020). With a high rate of poor households and a large proportion of workers working in the agricultural sector, communities in Bac Kan province are even more vulnerable to the effects of climate change.

2.2. Research methodology

To assess current capacity, challenges and capacity building demand of agricultural extension workers in the NMR of Vietnam in the context of climate change, a survey was conducted during 2021-2022. Agricultural extension staff in 8 districts/cities in Thai Nguyen province and 8 districts/cities in Bac Kan province were selected for the survey. The research team used a stratified sampling method to ensure representativeness of staff by location in each district, gender, age groups and field of expertise. Semi-structured questionnaires were used with the sample size of 151 respondents, including 26 leaders and 125 extension workers working at district and commune levels. Key research topics include:

(1) Assess current capacity of the agricultural extension workforce through: a) Demographic factors of agricultural extension workers including age, gender, education level, number of years of experience in the field of agricultural extension, etc.; b) Their understanding of climate change includes main sources of information on climate change, assessment of the impact of climate change on local agricultural production (on a scale of from 1, which is not at all concerned, to a scale of 5, which is extremely concerned), experiences related to adaptation to climate change, the content that workers have been trained on and their experiences in adapting to climate change (activities related to CCA) that they have been involved in within the last 5 years), and; c) Leaders' assessment and self-assessment of workers on professional knowledge/skills of workers according to 10 criteria and based on a scale of 1 to 5.

(2) Identify difficulties and challenges in agricultural extension activities caused by climate change: answers from the respondents were compiled and summarized in challenge categories.

(3) Capacity building demand of extension workers in the context of CCA. Multiple choice questions related to (a) the most common methods that extension workers used to learn new professional knowledge; (b) the learning methods that the workers consider to be the most effective; and (c) knowledge/skills that extension workers want to improve to carry out their professional tasks effectively. Respondents were allowed to add other answer beside the provided lists.

Synthesis and statistical analysis of data: Qualitative data from the interview was synthesized and summarized to draw main themes. Quantitative data were statistically analyzed using specialized statistical software SPSS, version 20.

3. RESULTS AND DISCUSSION

3.1. Overview of the agriculture extension system and current situation of climate change adaptation

3.1.1. Overview of the agriculture extension systems in the studied locations

3.1.1.1. Organizational structure of Agricultural extension systems

Since 2010, as specified in Decree No. 02/2010/ND-CP (The Government 2010), the agricultural extension system of Vietnam includes the following levels:

National level: National Agricultural Extension Center.

Provincial level: Provincial Agricultural Extension Center.

District level: Agricultural Extension Station.

Communal level: Agricultural extension cadres (1-2 staff).

In villages: agricultural extension collaborators and clubs.

By 2018, as specified in Decree No. 83/2018/ND-CP, Ministry of Agriculture and Rural Development performs the state management of agricultural extension activities. People's Committee at provincial, district and communal levels perform the state management of agricultural extension activities in their territory (The Government 2018).

However, during the implementation of Resolution No. 18 & Resolution No.19 issued by the Central Committee (2017a, 2017b), agricultural extension systems in provinces have not been restructured uniformly. Out of 63 provinces, provincial agricultural extension centers in 2 provinces have been dissolved. Agricultural extension station, Plant protection station and Veterinary medicine station at the district level were merged to form Agricultural Service Centers in 36 provinces. In many provinces, agricultural extension personnel in the communal level and villages have also been dissolved.

As a result of such restructure, agricultural extension systems in Bac Kan and Thai Nguyen provinces are also different to some extent (Fig. 1).

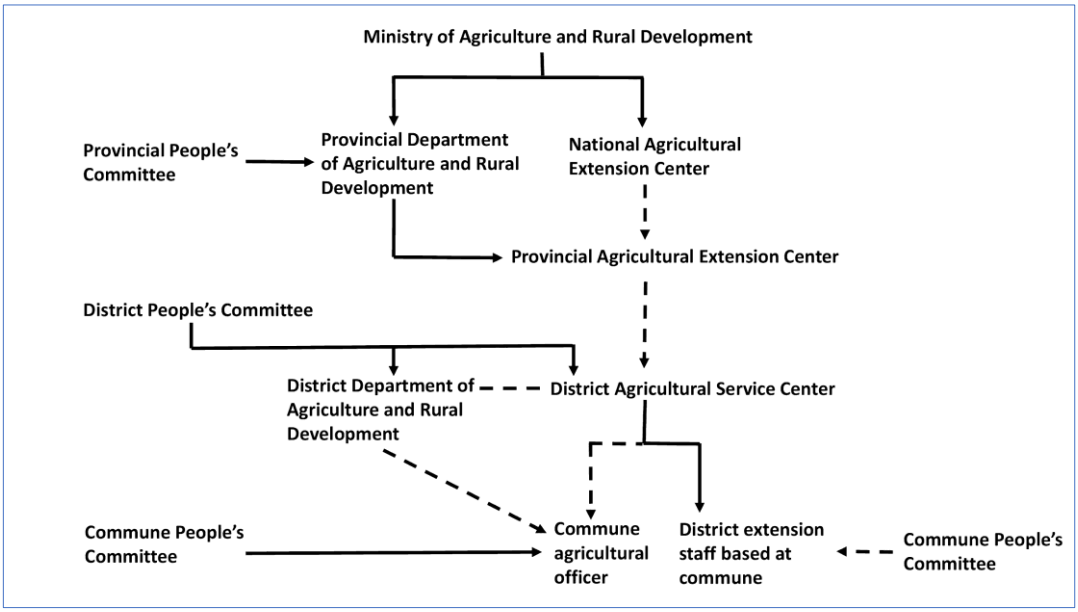


Figure 1. Organizational structure of agricultural extension systems

Both provinces have an Agricultural Extension Center at the provincial level and an Agricultural Service Center at the district level. There is no agricultural extension personnel in villages in both provinces. There is a difference between the two provinces at the communal level. In Thai Nguyen, in each commune, there is an extension staff who belongs to the District Agricultural Service Center but is based at the commune. Besides being responsible for extension activities in the commune assigned by the District Agricultural Service Center, these staff also support the Commune People's Committee in agricultural related activities. In Bac Kan, in each commune, there is a commune agricultural staff who belongs to the Commune People's Committee. They are mainly in charge of state management of agriculture in the commune. However, they are also being managed by the District Department of Agriculture and Rural Development in terms of profession. The District Agricultural Service Center has no authorized control over these commune agricultural staff but can collaborate with them in carrying-out agricultural extension activities.

In terms of the strength of the linkage among organizational levels, the agricultural extension system in Thai Nguyen province shows stronger connection from the provincial level to communal level while that of Bac Kan seems weaker. When being asked about the agricultural extension system in Bac Kan province, interviewed leaders responded that the linkage among levels has been broken and an appropriate fix is highly needed to ensure the sustainability of the system.

3.1.1.2. Main duties

In general, agricultural extension workers in Thai Nguyen and Bac Kan provinces have the following responsibilities:

Training Farmers: conduct training sessions and workshops to enhance the skills and knowledge of farmers. They educate farmers on modern agricultural techniques, sustainable practices, and proper use of new technologies and equipment.

Disseminating agricultural knowledge and relevant government policies: be responsible for sharing up-to-date information and best practices related to crop production, livestock management, pest control, soil fertility, irrigation, government policies and other agricultural related topics.

Setting up field trials for dissemination: set up demonstration plots to showcase new agricultural methods, technologies or new plant varieties and/or animal breeds.

Conducting farm visits: Extension officers regularly visit farms to monitor pests and diseases on plants and livestock to provide control and prevention advice and recommendations to local authorities and farmers.

Developing production plans and agricultural development projects: Develop annual agricultural production development plans and provide advice to local authorities on implementation of agricultural projects; implement agricultural projects and agricultural related policies.

Providing farmer advice and agricultural services: provide technical advice tailored to each crop season; supply plant seeds and animal breeds to farmers.

For agricultural staff at the communal level in Bac Kan province, the mentioned tasks only account for the minor part of their responsibility. They are mainly in charge of state management of crop production, animal husbandry, forestry, irrigation management, disaster prevention and management and implementation of governmental rural development projects.

3.1.2. Current situation of climate change adaptation in the studied locations

3.1.2.1. Current policies on climate change

Various CCA policies have been enacted in Vietnam over the last two decades (Espagne 2021). Among those, the three significant national adaptation policies that have been concretized to implement at the provincial level in Bac Kan and Thai Nguyen provinces are:

- Resolution 24-NQ/TW dated June 3, 2013 of the 11th Central Executive Committee on proactively responding to climate change, strengthening resource management and environmental protection;
- Decision No. 1670/QD-TTg dated October 31, 2017 of the Prime Minister approving the Target Program to respond to climate change and green growth for the period 2016 - 2020;
- Decision No. 1055/QD-TTg dated July 20, 2020 of the Prime Minister on promulgating the National Plan to adapt to climate change for the period 2021 - 2030, with a vision to 2050.

In the light of these national adaptation policies, provincial-level government in Thai Nguyen province has developed specific adaptation policies at their respective levels including:

- Decision No. 1013/QD-UBND dated May 18, 2012 of Thai Nguyen Provincial People's Committee approving the Action Plan to respond to climate change in Thai Nguyen province.
- Decision No. 1199/QD-UBND dated May 7, 2019 of Thai Nguyen Provincial People's Committee on approving the outline and estimate for implementing the task "Developing and updating an action plan to respond to climate change for the period 2021- 2030, vision to 2050 of Thai Nguyen province".

- Decision No. 4229/QD-UBND dated December 31, 2020 of Thai Nguyen Provincial People's Committee on promulgating the Action Plan to respond to climate change for the period 2021 - 2030, with a vision to 2050 of Thai Nguyen province.

In these documents, some key solutions and tasks to respond to climate change in the agricultural sector are proposed as follows:

- Widely apply biotechnology to create new plant varieties and animals with high yield, good quality, resistant to pests and diseases and able to adapt to climate change conditions. Transfer and replicate biotechnology products in agricultural production (crops, animal husbandry).
- Enhance afforestation, greening bare land and bare hills and mountains, protect and develop watershed protection forests and natural forests.
- Encourage the development of highly effective agricultural production models adapted to climate change conditions such as: Using drought-resistant varieties with high productivity and quality; change crop structure from rice land that does not actively have water to grow annual and perennial crops that require less water (compared to rice) and have high economic value; applying high technology in agricultural production, applying rice cultivation methods such as SRI improved rice intensive farming, 'Three reductions, three Gains' practice (reduce production costs, improve farmers' health, and protect the environment).
- Science and technology area: enhance the application of science and technology to transform the structure of crops and livestock, use appropriate farming methods and models, apply biotechnology and advanced production manual towards food safety, strengthen disease prevention and control systems in accordance with the ecological characteristics of regions and localities to proactively adapt to climate change.

In Bac Kan province, the aforementioned national adaptation policies have been concretized to implement at the provincial level in Decision No. 1841/QD-UBND dated October 12, 2020 of the People's Committee of Bac Kan province on approving the Action Plan to respond to climate change for the period 2021 - 2030, with a vision to 2050 of Bac Kan province. In particular, for the agricultural sector, there are the following tasks:

- Research and replicate models of crop and livestock restructuring suitable to climate change conditions and ecological characteristics of each region and locality, taking advantage of opportunities for sustainable agricultural development; Applying biotechnology and advanced production manuals towards modern and climate-resilient agriculture.
- Review and adjust land planning and arrange reasonable crop areas and structures to adapt to climate change; change production methods, apply advanced technology, gradually convert from small household scale to household group, cooperative, and production methods according to planning and market requirements.
- Promote the development of green agricultural production/organic agriculture, with low emissions, ensuring sustainable development, food security and contributing to hunger eradication and poverty reduction; Increase the use of organic fertilizers (green manure, manure, compost) and mulch using agricultural waste (straw, stubble, etc.) to increase the soil water holding capacity, increase soil fertility and reduce water evaporation.

- Continue strengthening research and implementation of planting crops that are resistant to weather changes, hot temperatures, unusual droughts, and severe cold events, suitable to the season and local conditions; Transform the structure of crops and livestock to improve economic efficiency per unit of cultivated area; Continue converting crop structure on rice land areas that are suffering from water shortage and drought. Key crops are identified for conversion, including: Corn, vegetables, soybeans, peanuts, taro, potatoes, turmeric, edible canna, tobacco, ginger, fragrant squash, watermelon, melon, citrus, and seedless persimmons, etc.

It is worth noting that, CCA policies for solely agricultural sector or agricultural extension or capacity building for extension workers in the context of climate change have not been developed in the studied areas. Agriculture is only a sector in existing CCA provincial-level policies. The proposed solutions and tasks to respond to climate change for this sector somehow remain too general for implementation. These solutions and tasks also focus mainly on technical reactive responses, there is a significant lack of guideline for capacity building and financial resources. As a result, localities do not have separate programs for CCA in agriculture. CCA related activities are mainly integrated into other programs and have the nature of overcoming the effects of climate change case by case (see section 3.1.2.2 for more details).

3.1.2.2. Current climate change adaptation initiatives in the surveyed locations

According to responses from interviewed agricultural extension leaders and workers, although there had not been a separate program for CCA, the following CCA initiatives had been promoted in their agricultural extension activities in order to deal with existing impact of climate change in local areas.

- Grow short production cycle crops to avoid periods with high risk of extreme weather events.
- Modify crop structure: conversion from rice-based to other upland crops (maize, legumes, pasture and local specialty crops such as edible canna and *Chinese mesona* or fruit trees to adapt to water shortage and drought conditions.
- Select crops and introduce new varieties with high yield, high quality and enhanced resilience under harsh climatic conditions, and pest and disease infestation, etc..). Currently, the set of plant seeds is diverse, but mainly for increasing productivity and quality, there are not many climate-resilient varieties available.
- Adopt sustainable cultivation practices (e.g. System of Rice Intensification (SRI), Integrated Pest Management (IPM), produce compost from rice straw and microorganisms, apply slow-release fertilizers, use organic fertilizers, adopt Good Agricultural Practices or organic standards, and adopt agroforestry practices on sloping land, etc.
- Diversification strategy to increase income per area: e.g. rice-fish system.
- Plant trees, reforest and protect forests to conserve water, reduce the impact of drought and flood.
- Apply high and/or improved technology into production (e.g. greenhouse crop production, water saving techniques, etc.) to avoid adverse weather impacts.

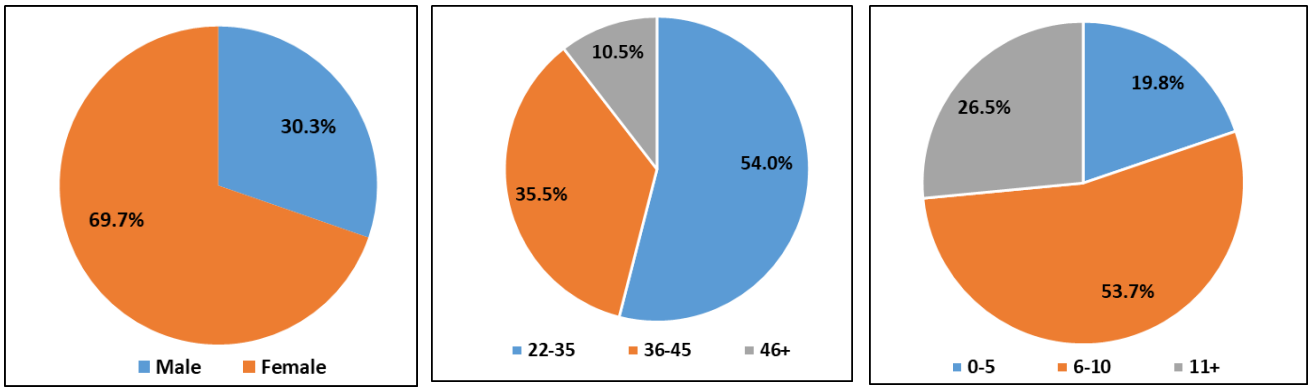
- Growing grass, preparing, processing, and storing grass for fattening livestock (buffaloes, cows, and horses) to be proactive in assuring food sources in unfavorable weather conditions (dry season, rain, cold, flood, etc.).
- Building barns for housing livestock (buffaloes, cows, chickens) to reduce free grazing, provide shelter for livestock from extreme weather (e.g. heat and cold), prevent the spread of diseases.
- Select livestock suitable to local natural and climatic conditions (e.g. hybrid pigs from wild boar and local breeds).
- Apply farm biosecurity management and Good Agricultural Practices to livestock farming (pigs and poultry).
- Use biological products in livestock farming: use probiotic fermentation bed for breeding livestock and poultry; use biological products to ferment food and treat livestock waste; treat livestock waste using biogas tanks.

3.2. Current capacity of local agricultural extension system

3.2.1. Demographic characteristics of agricultural extension workers

3.2.1.1. Gender, age and work experience

An interesting observation is that female accounted for a major part of the workforce (69.7%), doubled the proportion of male workers (30.3%) (Fig 2a). The workforce has a relatively young age with 54% of the workers aging between 22-35 years old, 35.5% aging between 36-45 years old and only 10.5% aging 46 years old or older (Fig 2b). More than half of the extension agents had a job experience between 6-10 years, while a quarter of them had 11 years of experience or more, only 20% of them were young workers who had less than 5 years of experience (Fig 2c).



(a) *(b)* *(c)*

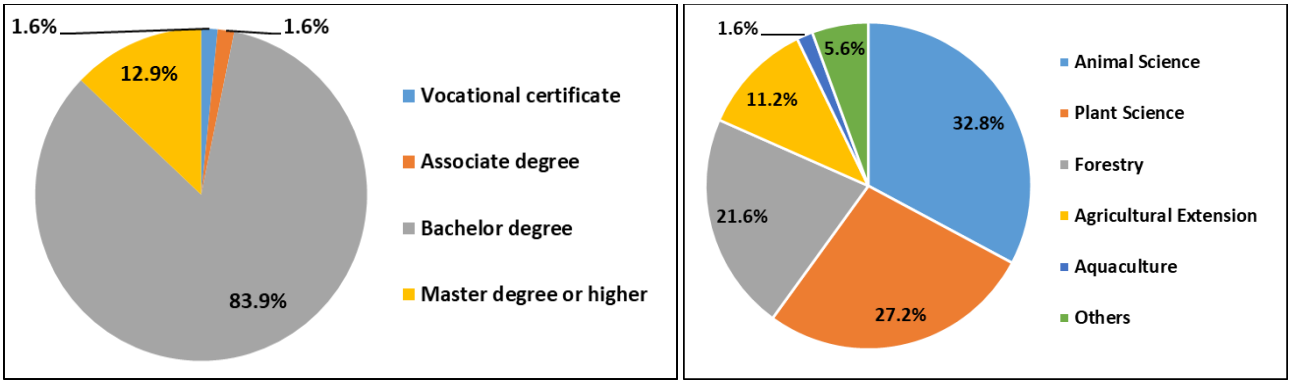
Figure 2. Gender, age and years of experience of extension workers (n=125)

(Source: Fieldwork 2021-2022)

3.2.1.2. Education

Level of education

Almost all interviewed extension staff holds a tertiary degree with 83.9% of them had a bachelor degree, 12.9% had a master degree or higher. Those who hold an associate degree or a vocational certificate accounted for only 1.6% each (Fig 3a).



(a) *(b)*

Figure 3. Level of education and major field of study of extension workers (n=125)

(Source: Fieldwork 2021-2022)

Major (field of study/specialization)

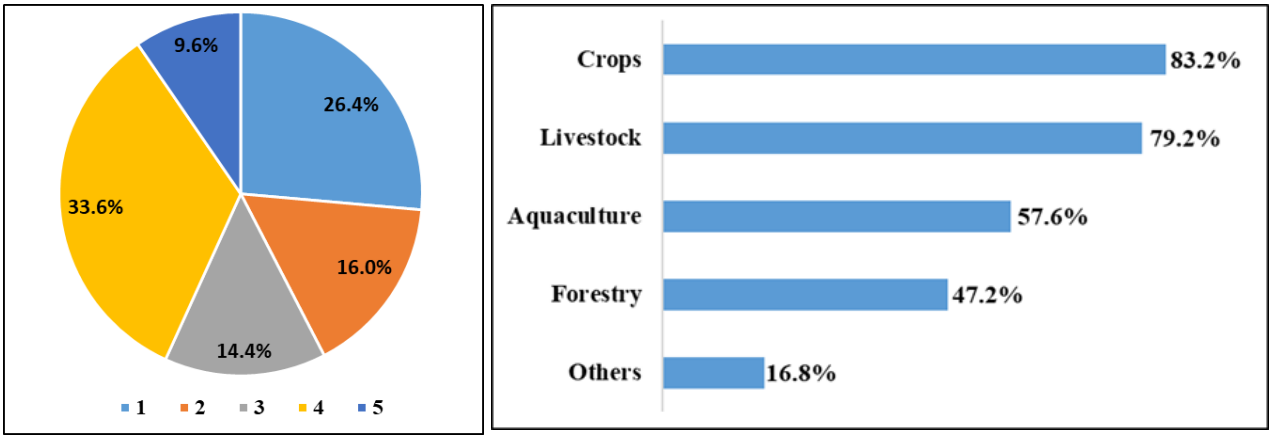
The main majors that interviewed extension workers were educated include Animal Science, Plant Science and Forestry as these are the main fields of production in local rural areas. The proportion of workers educated in such majors accounted for 32.8%, 27.2% and 21.6%, respectively (Fig 3b). There were also 11.2% of the workers educated in the Agricultural Extension major. In this major, they studied multi-disciplines about animal, plant, rural economic, etc. but to gain general understanding rather than in-depth studies in a specific field. To this day, this major is no longer offered by local universities since the performance at work of former graduates was not as good as those who were trained intensively in one major. Because aquaculture was not very developed in Thai Nguyen and Bac Kan provinces, demand of extension agents for this area was relatively low. Only 1.6% of the interviewed agents hold a degree in this major. Besides the mentioned majors, there were 5.6% of the interviewed workers hold a degree in other majors, including Agricultural Economics, Irrigation Management, Law, and Environmental Science (Fig 3b).

3.2.1.3. Areas of specialization at work

Despite the fact that most of the interviewed extension workers were trained in one specialized discipline, only 26.4% of the interviewed staff was able to work solely in their trained professional area. Most of them (73.6%) needs to provide services in 2 to 5 different disciplines which are crops, livestock, aquaculture and forestry, etc. (Fig 4a). Taking on too many tasks in non-trained discipline affects the quality of an extension worker to some extent. Further discussions during the interview process noted that, while this fact has little impact on district-level staff because they have formal support from colleagues (in the same unit) with relevant expertise when needed, a part of agricultural

workers (mainly at the commune level) faces more difficulties due to lack of this support; each commune usually has only one officer in charge of agriculture.

When being asked about the areas of specialization that each extension staff was responsible for, the majority of them responded that they need to provide services in crops and livestock, 83.2% and 79.2% respectively. For aquaculture and forestry, the figure was 57.6% and 47,2% respectively. A small proportion of extension workers (16.8%) was responsible for other tasks, including Program 135 (poverty alleviation), the National Target Program for New Countryside Development, One Commune One Product (OCOP) Program, irrigation management, and natural disaster prevention and control, etc. (Fig 4b).



(a) *(b)*

Figure 4. Areas of specialization at work of extension workers (n=125)

(Source: Fieldwork 2021-2022)

3.2.2. Understanding about climate change

3.2.2.1. Information sources for learning about climate change

Regarding sources where extension workers learned about climate change, collected data showed that newspaper, radio/television and the internet were main information channels (Fig 5). Almost all of the interviewed respondents (97.4%) stated that they learned about climate change through such media. The respondents also learned about climate change through professional development workshops and training workshops on climate change. However, the proportion of respondents learning via these channels was quite low, accounted 47.0% and 41.0% respectively.

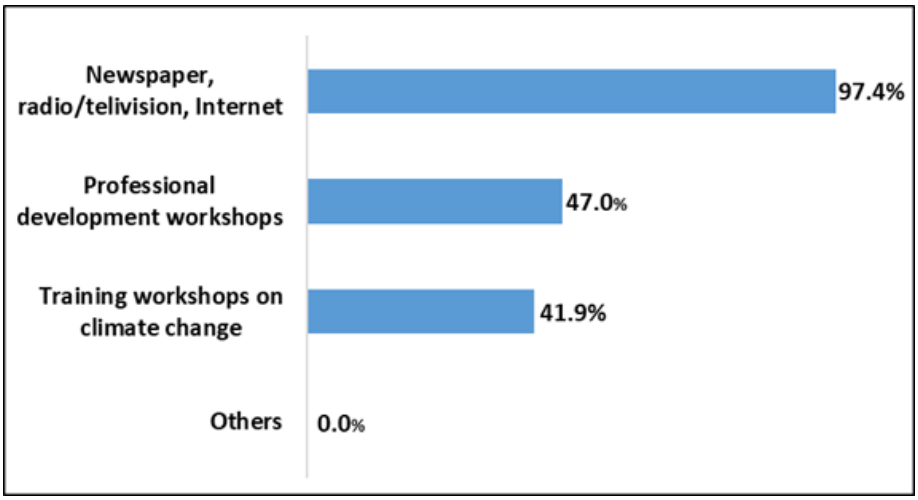


Figure 5. Information sources for learning about climate change of extension workers (n=125)

(Source: Fieldwork 2021-2022)

3.2.2.2. Self-assessment on understanding about climate change

Extension workers were asked to assess themselves on the understanding about climate change including causes, adverse impact, mitigation measures, adaptation measures in agriculture. The highest proportion of respondents (42.2%) rated themselves to have fair understanding about climate change. On the other hand, the figure seemed to be fairly similar for good – very good versus poor-very poor understanding. The former group accounted for a proportion of about 30%, in which 9.2% rated to have very good understanding and 21.1% rated to have good understanding. The latter group accounted for a proportion of about 27%, in which the proportions of having poor and very poor understanding were 16.5% and 11.0% respectively (Fig 6).

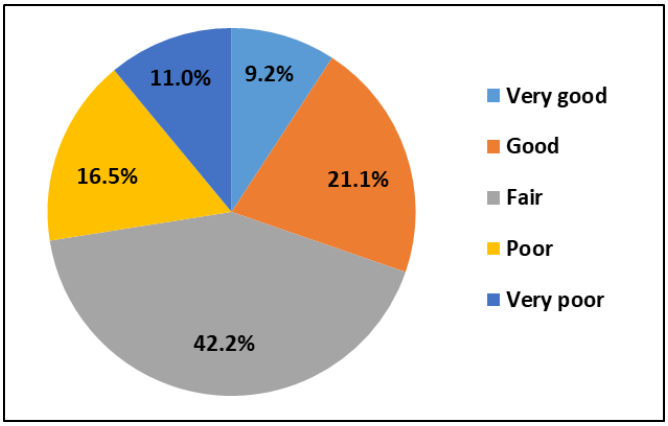


Figure 6. Self-assessment on understanding about climate change (n=125)

(Source: Fieldwork 2021-2022)

3.2.2.3. Signs of climate change in local areas and causes of climate change

To test the understanding of extension workers on climate change, they were asked to determine if there were signs and/or indication of climate change in their local areas and to determine the causes of climate change. Most of respondents believed that there were signs of climate change in the local areas (96.0%), only a small proportion of them (3.5%) stated that there was insufficient evidence to conclude (Fig 7).

Data revealed that the extension staff had different perspectives regarding the causes of climate change. A large proportion of them (71%) believed that the phenomenon is initiated by both human activities and nature. About one-fifth of the respondents stated that the cause was human activities. Only a small proportion of them (5.3%) assumed that the causes was nature itself while 3.5% stated that there was not enough evidence for them to determine the cause (Fig 7).

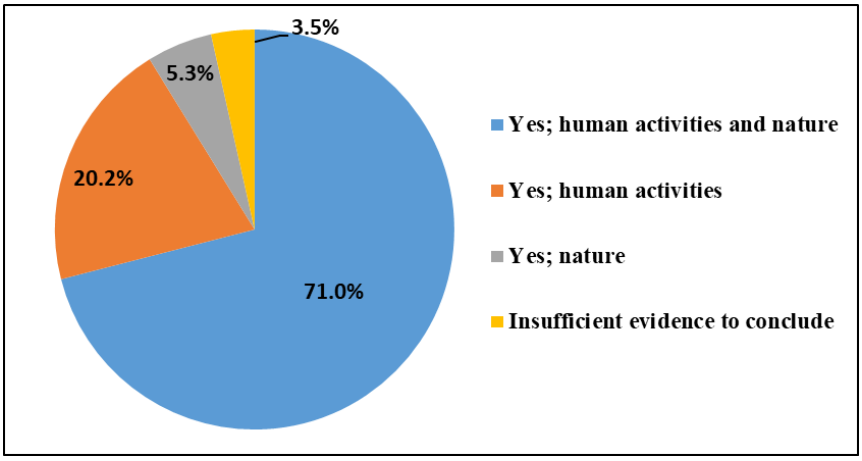


Figure 7. Signs of climate change in local areas and causes of climate change (n=125)

(Source: Fieldwork 2021-2022)

3.2.2.4. Climate change phenomena in local areas

According to the responses of interviewed extension leaders and workers, signs of climate change were clear and diverse. The most common phenomena were increased extreme weather events and unpredictable changes of temperature with 70.4% and 66.9% of respondents stated, respectively. These were followed by heat waves and heavy rainfall with percentages of selection at 52.8 % and 49.3%, respectively. Another group of stated climate change indicators were prolonged drought (42.3%), flood (39.4%) and prolonged rainfall (38.7%). Warmer winter (29.6%) was one of the indicated signs, but not as common as aforementioned signs. There were also other signs of climate change mentioned in the responses. However, these accounted for only 2.1% (Fig 8). These signs included the decrease of mountain water resource and unusual cold days in summer time (in May).

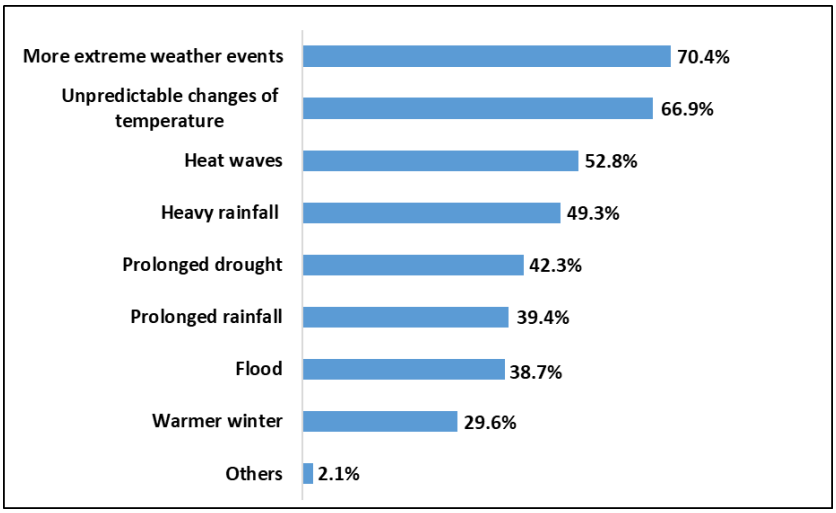


Figure 8. Climate change phenomena in local areas (n=151)

(Source: Fieldwork 2021-2022)

3.2.2.5. Impacts of climate changes on local agricultural production

Results indicates that the respondents were generally concerned about the adverse effect of climate change on local agricultural production. A high proportion of respondents (42.9%) indicated that they were extremely concerned about the impact, while 21.1% and 27.1% of them were very concerned or moderately concerned about the impact. Only a very small proportion of workers showed a little or not at all concerned about the impact at 7.5% and 1.5% respectively (Fig 9).

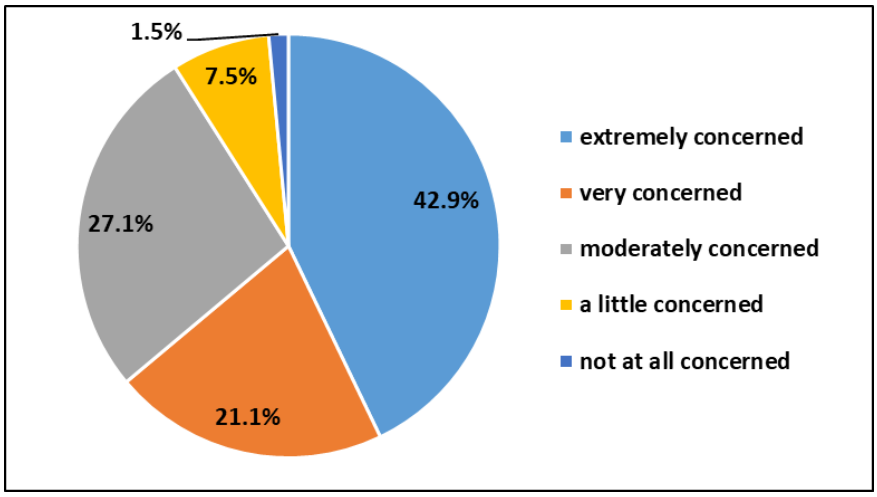


Figure 9. Level of concern about the impacts of climate changes on local agricultural production (n=151)

(Source: Fieldwork 2021-2022)

3.2.2.6. Contribution of local agricultural production activities to climate change

Most extension workers (74.3%) believed that local agricultural production activities contributed to climate change. However, approximately a quarter of them stated that the activities had no contribution (Fig 10).

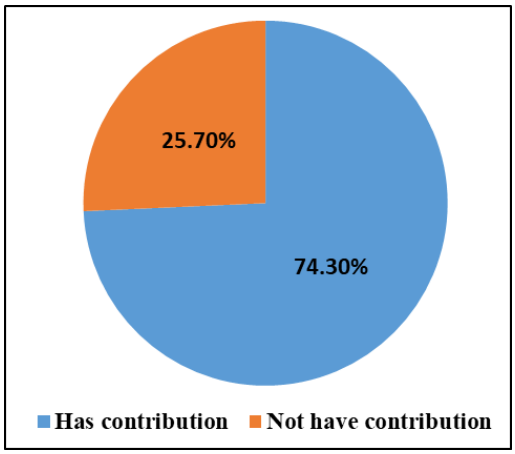


Figure 10. Contribution of local agricultural production activities to climate change (n=125)

(Source: Fieldwork 2021-2022)

3.2.2.7. Experience in climate change adaptation

The extension workers were asked about their participation in activities related to CCA in agriculture. Results were used to have an overview on their experience in CCA. More than half of the extension workers (58.1%) had participated in extension activities related to CCA such as dissemination, carrying out training and transferring agricultural techniques. However, the proportion of workers without experience in CCA was relatively high at 41.9% (Fig 11a).

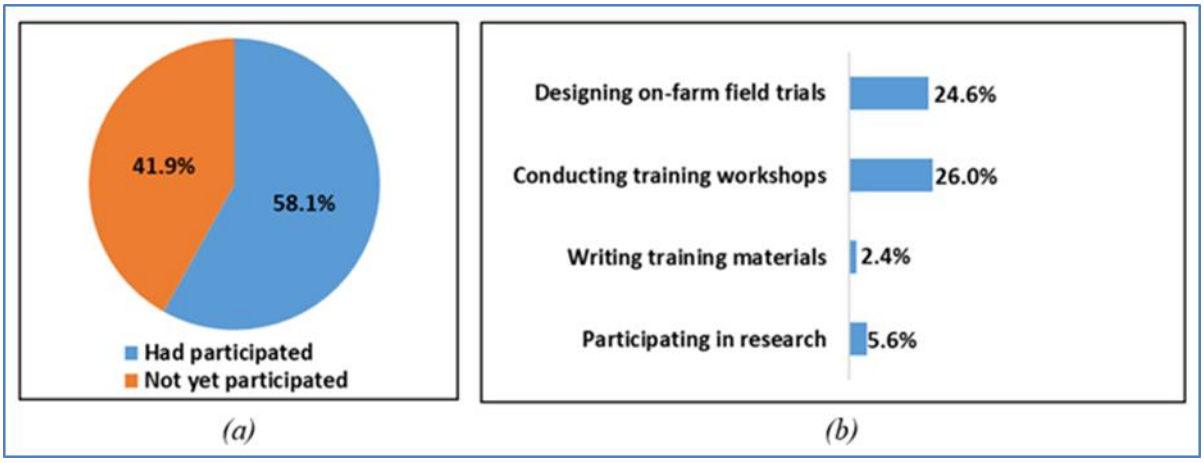


Figure 11. Experience in climate change adaptation (n=125)

(Source: Fieldwork 2021-2022)

Extension workers were also asked to specify the climate-change adaptation activities that they participated in the last 5 years. Carrying-out training workshops for local farmers and designing on-farm demonstrations were the most common activities performed. However, the proportion of the respondents had carried-out these activities was quite low, at only 26.0% and 24.6% respectively. A small proportion of workers stated that they had participated in technical research (5.6%) and writing training materials (2.4%) (Fig 11b).

3.2.3 Technical training received

Regarding training that extension workers received, up to 59% of them was trained on agricultural extension methods and 35.2% was trained on climate-change adaptation in agriculture (Fig 12).

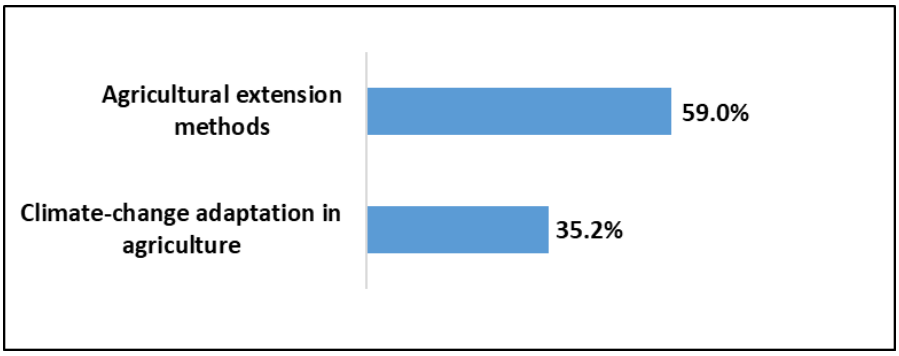


Figure 12. Training that extension workers have received (n=125)

(Source: Fieldwork 2021-2022)

3.2.4. Self-assessment of professional capabilities

In general, the competency score of agricultural extension officers was in the range of 2.5 to 4.0 in all criteria and the two groups of respondents (leaders and extension workers) give quite similar scores in the criteria. While knowledge/skills related to self-study and extension activities are generally rated above average (out of 3 points), competencies related to CCA have lower scores and leaders also give lower scores than their officers (Fig 13).

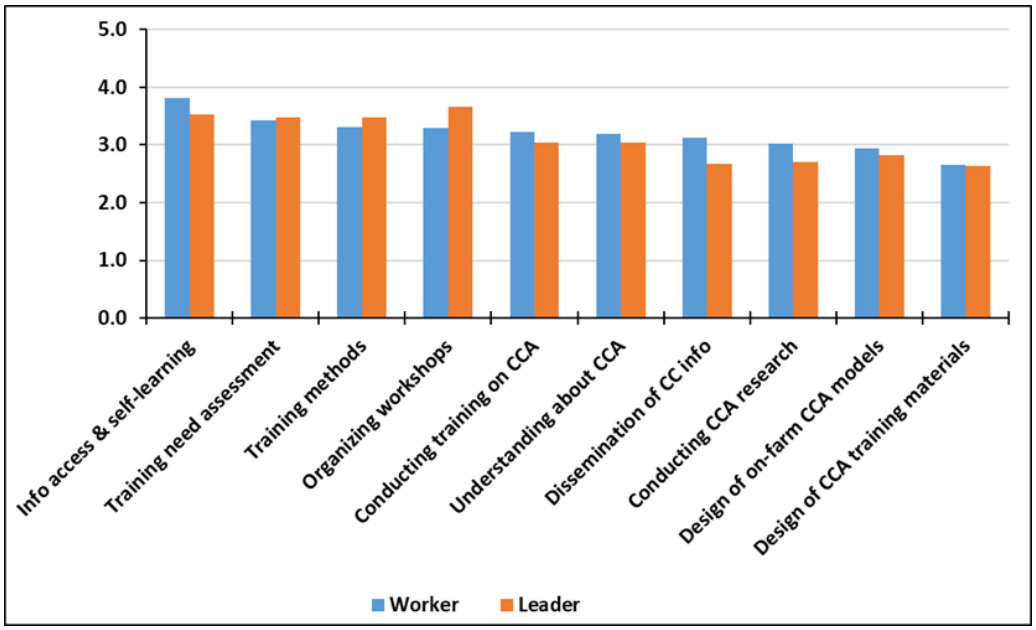


Figure 13. Self-assessment of professional capacity of extension workers (n=125)

(Source: Fieldwork 2021-2022)

3.3. Advantages and Difficulties of agricultural extension activities

3.3.1. Advantages

- Local agricultural extension has received attention and direction from all levels of the government and support from grassroots.
- Extension staff from provincial to commune level are professionally trained and experienced.
- There are extension workers at the grassroots level in each commune to direct agricultural production.
- Better roads to communes and villages in many areas make travel for farm visits and other extension activities easier.
- Plant seeds, animal breeds and machinery supplies are reliable.
- For areas which are closed to regional universities, training workshops are regularly provided.

3.3.2. Difficulties induced by climate change

Travel for farm visits and other extension activities became more difficult due to heavy rain and more frequent/intense extreme flood events. Especially, in remote mountainous areas where transportation infrastructure is not well-developed. Flooding can easily damage low quality roads, bridges and isolate such areas from the outside world. The isolation not only prevents extension workers from approaching communities but also prevent farmers from attending training activities.

Development and implementation of agricultural production plans (select and recommend crops/animals for each growing season, create cropping calendar) became passive due to unpredictable weather such as erratic drought or heavy rainfall, unusual hot days in winter.

Examples: Weather patterns caused by climate change such as unusual warm periods or unpredictable changes in temperature in winter have caused extension workers and farmers to **fail in scheduling flower production and reduced flower yield and quality**. Cut flowers and flowering ornamentals usually gain better price when their flowering time meets special celebrations such as New Year's holiday. Thus, floricultural farmers may schedule their flower production to timely suit market demand. However, flowering time of many plants is affected by environmental stimuli such as light and temperature. For example, low temperature can reduce plant growth and prolong time to flowering and vice versa.

Difficulties in forecasting and monitoring pests and diseases on plants and animals

Pest monitoring and forecasting for plants became more difficult due to the changes of pest outbreak caused by unpredictable weather. Studies also indicate that under climate-change scenarios, pest risk for plants will increase in agricultural ecosystems and subtropical regions is one the strongly affected areas (IPPC Secretariat 2021).

The occurrence and severity of animal infectious diseases in agricultural systems has been increased. Thus, forecasting and monitoring has been more challenge. The phenomena are expected to increase under the influence of climate change (Stephen and Soos, 2021).

Workload of extension workers has becoming heavier as an indirect result of climate change. Unusual weather patterns during cropping seasons require more time and effort for rescheduling production plans. In addition, increased occurrence and severity, and emergence of new of plant pests and animal diseases require more time for site visits, forecasting and monitoring activities. Extension workers also need more time to learn about new pests and diseases.

Dissemination of new technologies to farmers sometimes cannot keep up with changes of production conditions. For example, new potential rice variety was selected based on normal weather condition of the area. However, when the new cropping season comes, weather suddenly change and such new variety is no longer suitable. Moreover, demonstration plot models are at higher risks of the damage caused by extreme weather events such as drought, heavy rain, flood, pests and diseases, etc.

Lack of climate-smart production manuals and not many CCA models have been built.

It is more difficult for extension workers to motivate farmers to invest in agricultural production (e.g. adopt new/advanced technologies) under the impact of climate change. Agricultural production in the area is mainly small-scale and highly dependent on nature so that it is risky and highly vulnerable to the impacts of climate change. As there are many disadvantages from weather conditions., investment of farmers in agriculture has been decreasing. Consequently, the dissemination of new/advanced technologies to farmers is more difficult.

3.3.3. Other difficulties

- Many extension workers, especially those who work at grassroots level, must take on many non-professional tasks which affects their professional work.
- Extension workers have not received adequate, regular and timely training on new technology to catch up with actual conditions.
- The current organizational structure of agricultural extension system in Bac Kan province is believed to weaken the connection among agents at the provincial - district - commune levels and limit the effectiveness of the system.
- Current salary and allowances for agricultural extension workers are considered not reasonable for their particular work (working outdoors, regular travel for farm visits and other extension activities, exposure to pesticides).
- Human resources and funding for agricultural extension activities are still low and funding for on-farm demonstrations and science and technology transfer projects is limited.
- There is a lack of official information sources to support agricultural extension workers' duties and their professional capacity development. The workers mainly obtain and have to use unofficial information that they can search on the internet since the information they need is not officially available.

3.4. Training demand

3.4.1. Main ways/methods of learning new professional knowledge

Survey result shows that reading technical documents, searching on the internet and attending training courses were the most common learning methods used. These methods were used by 58.3%, 55.7% and 54.8% of the workers, respectively (Fig 14). The second group of most commonly used methods were experiential learning and peer learning, used by 47.0% and 41.7% of the workers, respectively. Study visits to other localities for learning purpose was not commonly used, only 23.5% of the workers used this method. Very few workers (1.7%) learned new professional knowledge by participating in professional associations on websites or social networks (Fig 14).

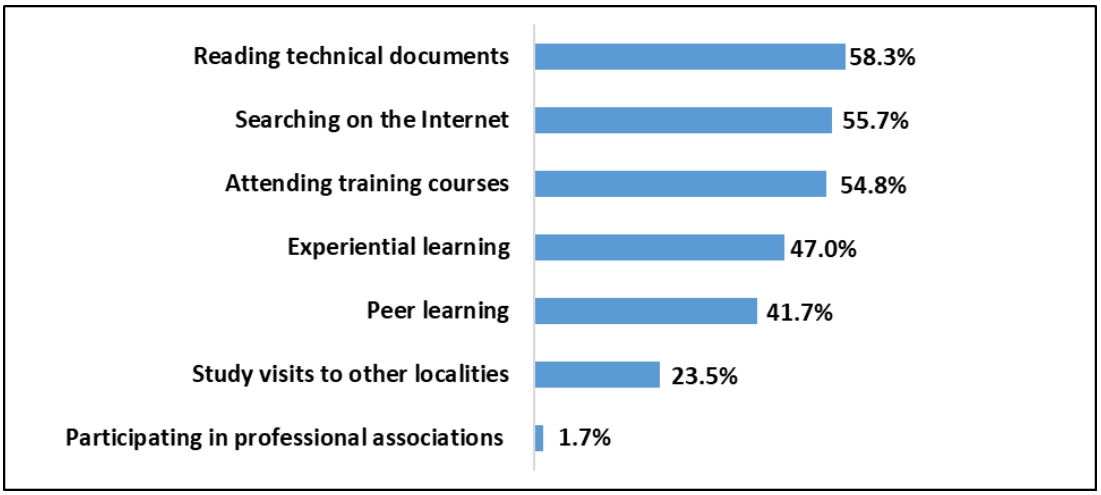


Figure 14. Main ways/methods of learning new professional knowledge (n=125)

(Source: Fieldwork 2021-2022)

3.4.2. Most effective learning methods

Survey results reveals that experiential learning, attending training course and study visits to other localities were believed to be effective most. These methods were selected by 73.4%, 62.1% and 50.0% of the workers, respectively (Fig 15). On the other hand, peer learning, reading technical documents and searching on the internet were believed to be effective by a smaller proportion of the workers, around 20%. Learning by participating in professional associations on websites or social networks was the method received the least attention, being selected by only 15.3% of the workers (Fig 15).

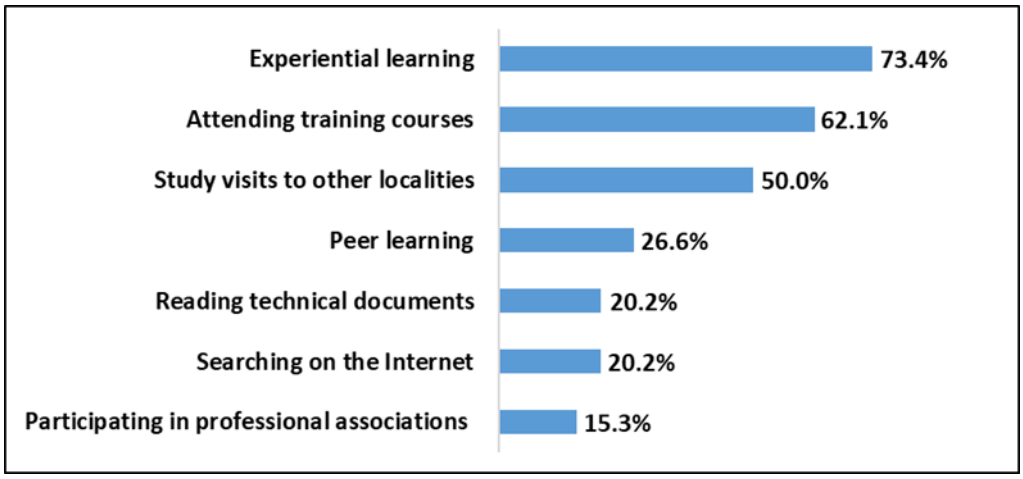


Figure 15. Most effective learning methods (n=125)

(Source: Fieldwork 2021-2022)

3.4.3. Training demand

Climate-smart production manuals (for crops and domestic animals) was chosen by the largest proportion of the respondents at 82.5% (Fig 16). Networking and shared learning (for documents, knowledge and experience sharing among extension workers) and effective extension communication methods for local farmers were chosen by the second largest proportion of the respondents at 69.7%, equally. Competency in designing on-farm demo-plots and ability to implement on-farm research on CCA ranked third in order of importance, selected by around 40% of the respondents. Three abilities including training need assessment, organizing and facilitating training workshops effectively and designing dissemination and communication materials (leaflet, video and contents on broadcast, television, etc.) received less attention compared to those mentioned above, chosen by around one-third of the workers. Ability to design training materials and self-learning ability were chosen by the least proportion of workers. Only less than 20% of the workers wanted to improve these abilities (Fig 16).

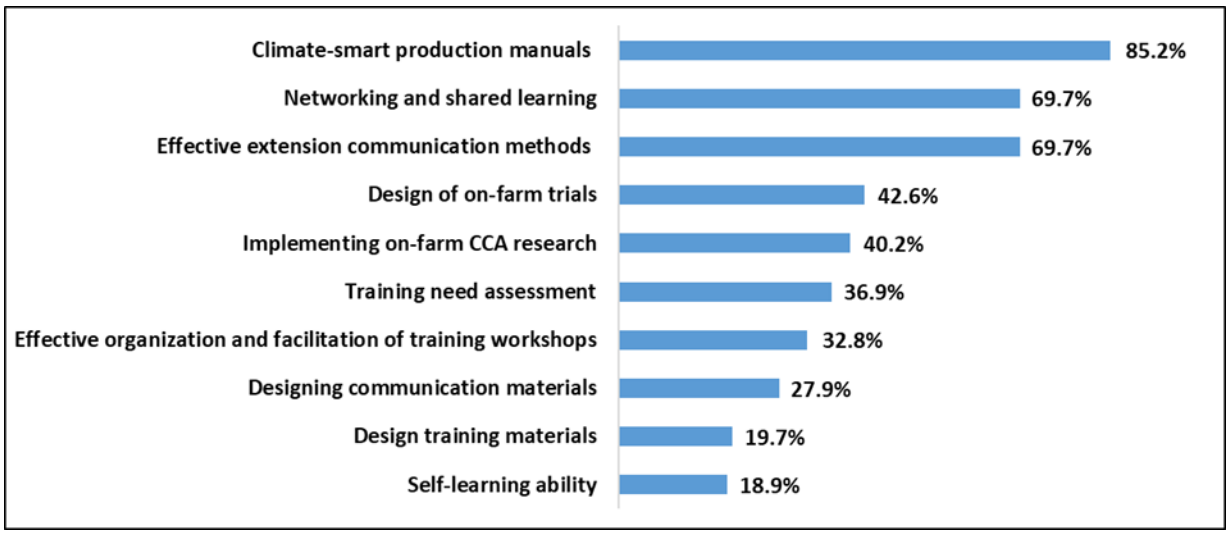


Figure 16. Abilities that extension workers want to improve (n=125)

(Source: Fieldwork 2021-2022)

3.5. Recommended polices and support mechanism

Leaders and workers participating in the survey were asked to make recommendations for improving capacity of agricultural extension workers in the context of climate change. Recommendations of respondents are classified and summarized as below:

- Need to have capacity building policies: through providing information on climate change and CCA in agriculture (training, site visits for learning and experience sharing about climate change; network for sharing information about effective practice between agricultural extension units in localities; systems to provides forecasts on weather, pests, diseases on crops and livestock to agricultural extension workers in a complete, accurate and timely manner.

- In addition to professional knowledge and skills, agricultural extension workers also need to be equipped with market knowledge and soft skills (searching and exploiting information, propagating, working with farmers and cooperate with relevant agencies, identify - solve problems, develop plans, etc.).
- For long-term capacity building: Training programs at universities needs to be more practical. Theories should be coupled with practice.
- There should be studies on CCA specific to each locality.
- Each locality should have a new-technology testing area for agricultural extension workers to do trial test before disseminating to farmers. In addition, there should be available funding for building climate-resilient demonstrations in localities.
- Salary and allowances for agricultural extension workers (including grassroots agricultural extension members) need to be improved (per diem, allowances for farm visits, gasoline for transportation, allowances for outdoor activities, allowances for exposure to pesticides when visiting fields, etc.) to improve their incentive and dedication to their professional work.
- Localities in remote areas, scattered areas, areas that are difficult to approach should be equipped with information dissemination systems such as speakers and radios to receive information timely.
- It is necessary to restructure agricultural extension agencies from provincial level to commune level to consolidate the strength of agricultural extension system. It is recommended to strengthen the force of agricultural extension at the grassroots level (by increase number and ability of agricultural and forestry officers in communes, grassroots agricultural extension workers, grassroots veterinarians) to improve the efficiency of the agricultural extension system.

4. CONCLUSIONS AND RECOMMENDATIONS

Agricultural extension in northern mountainous region of Viet Nam has advantages in terms of qualifications and work experience. Most agricultural extension staff have been trained with agricultural extension methods. Nonetheless, only a small proportion of staff have been trained or have experience in climate change adaptation.

The main difficulties/challenges encountered due to climate change include (1) difficulties in traveling for farm visits and other extension activities, (2) difficulties in developing implementing production plans, (3) difficulties in pests and diseases forecast and management, (4) increased workload as an indirect result of climate change (5) community outreach and/or communication activities faces many difficulties, especially in localities with ethnic minorities, scattered housing locations, and difficult travel, (6) lack of climate-smart production manuals, climate change adaptation models, (7) difficulties in motivating farmers to invest in agricultural production.

Technical manuals for climate-resilient production, networking and shared learning, and effective agricultural extension communication methods are the main learning resources that the agricultural extension workers want to be equipped to effectively carry out their professional tasks under the context of climate change.

Recommendations for enhancing capacity of agricultural extension workforce include equipping extension staff with (1) adequate information regarding climate change, (2) information sharing network, (3) proactive forecast system for weather, pests and diseases on crops and livestock and (4) not only professional knowledge and skills but also market knowledge and soft skills; For long-term capacity building, (5) more practical training programs at universities, (6) locally tailor-made climate change adaptation studies, (7) new-technology testing area for each locality and (8) better salary and allowances for agricultural extension workers are required. In addition, (9) localities in remote areas should be equipped with better information dissemination systems, (10) it is necessary to restructure agricultural extension agencies from provincial level to commune level to consolidate the strength of agricultural extension system.

REFERENCES

Antwi-Ageyi, P. & Stringer, L. C. (2021). Improving the effectiveness of agricultural extension services in supporting farmers to adapt to climate change: Insights from northeastern Ghana. *Climate Risk Management*, vol.32 (2021) 100304, pp.1-13.

Bac Kan Portal (2020). *Overview of Bac Kan province*. Website: https://backan.gov.vn/pages/gioi-thieu-chung-ve-tinh-bac-kan.aspx, [accessed Aug 24, 2023].

Care International in Vietnam (2013). *Climate vulnerability and capacity of ethnic minorities in the northern mountainous region of Vietnam*. Website: https://careclimatechange.org/cvca-ethnic-vietnam/, [accessed May 19, 2023].

Central Committee (2017a). *Resolution No. 18-NQ/TW dated 25/10/2017 on some issues of continual renewing, streamlining the organizational apparatus of the political system, operating effectively*. Website: https://tulieuvankien.dangcongsan.vn/van-kien-tu-lieu-ve-dang/hoi-nghi-bch-trung-uong/khoa-xii/nghi-quyet-so-18-nqtw-ngay-25102017-hoi-nghi-lan-thu-sau-ban-chap-hanh-trung-uong-dang-khoa-xii-mot-so-van-de-ve-tiep-568, [accessed May 19, 2023].

Central Committee (2017b). *Resolution No.19-NQ/TW dated October 25, 2017 on continuing to renovate organizational and management structure, enhance quality and efficiency of public service provider).* Website: https://tulieuvankien.dangcongsan.vn/van-kien-tu-lieu-ve-dang/hoi-nghi-bch-trung-uong/khoa-xii/nghi-quyet-so-19-nqtw-ngay-25102017-hoi-nghi-lan-thu-sau-ban-chap-hanh-trung-uong-dang-khoa-xii-ve-tiep-tuc-doi-moi-va-569, [accessed May 19, 2023].

Espagne E. (ed.), Ngo-Duc, T., Nguyen, M.H., Pannier, E., Woillez, M.N., Drogoul, A., Huynh, T.P.L., Le, T.T., Nguyen, T.T.H., Nguyen, T.T., Nguyen, T.A., Thomas, F., Truong, C.Q., Vo, Q.T., Vu, C.T. (2021). Climate change in Viet Nam; Impacts and adaptation (Chapter 11). A COP26 assessment report of the GEMMES Viet Nam project. Paris. Agence Française de Développement.

Food and Agriculture Organization (FAO) (2023). *Climate Smart Agriculture Sourcebook*. Website: https://www.fao.org/climate-smart-agriculture-sourcebook/enabling-frameworks/module-c2-supporting-rural-producers/chapter-c2-2/en/, [accessed Aug 24, 2023].

GSO (2019). *The Viet Nam Population and Housing Census of 00:00 hours on 1 April 2019: Implementation organisation and preliminary results*. Website: https://www.gso.gov.vn/wp-content/uploads/2019/10/bao-cao-so-bo-dan-so.pdf, [accessed Aug 22, 2023].

GSO (2020). *Results of Survey on the socio-economic situation of 53 ethnic minorities carried out in 2019*. Website: https://www.gso.gov.vn/wp-content/uploads/2020/07/02-Bao-cao-53-dan-toc-thieu-so-2019_ban-in.pdf, [accessed Aug 22, 2023].

GSO (2022). *Report on labour force survey 2021*. Website: https://www.gso.gov.vn/wp-content/uploads/2023/03/Ruot-Dieu-tra-LD-viec-lam-Can1-1.pdf, [accessed Aug 22, 2023].

IPCC (2022), *Technical Summary*. In: *Climate Change 2022: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Sixth Assessment Report of the

Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 37–118.

Meera, S.N., Balaji, V., Muthuraman, P., Sailaja, B., Dixit, S. (2012). *Changing Roles of Agricultural Extension: Harnessing Information and Communication Technology (ICT) for Adapting to Stresses Envisaged Under Climate Change*. In: *Crop Stress and its Management: Perspectives and Strategies*. Springer: Dordrecht.

MOLISA (2022). *Decision No. 125/QD-LDTBXH dated February 22, 2022 Announcing the results of reviewing poor and near-poor households in 2021 according to the multi-dimensional poverty standard applied for the period 2016-2020*.

Bac Kan PPC (2020). Action Plan to respond to climate change for the period 2021 - 2030, vision to 2050 of Bac Kan province. *Bac Kan Official Gazette*, No. 30, October 23, 2020.

Bac Kan PPC (2021). *Decision No. 473/QD-UBND dated April 8, 2021 promulgating the Program to support labor market development and job creation in Bac Kan province for the period 2021 - 2025*.

Thai Nguyen Portal (2021). *General introduction about Thai Nguyen province*. Website: https://en.thainguyen.gov.vn/thainguyen-overview/-/asset_publisher/C5kLAFKpcbtS/content/general-introduction-about-thai-nguyen-province?redirect=%2Fthainguyen-overview&inheritRedirect=true, [accessed Aug 23, 2023].

The Government (2010). *Decree No. 02/2010/ND-CP dated January 08, 2010 of the Government on agricultural extension*. Website: https://vanban.chinhphu.vn/default.aspx?pageid=27160&docid=92648, [accessed May 19, 2023].

The Government (2018). *Decree No. 83/2018/ND-CP dated May 24, 2018 of the Government on agricultural extension*. Website: https://english.luatvietnam.vn/decree-no-83-2018-nd-cp-dated-may-24-2018-of-the-government-on-agricultural-extension-163398-doc1.html, [accessed May 19, 2023].

Ha, M.T., Truong, T.A.T, Hoang, T.T.H., Ho, V.B. (2020). Drivers, Barriers and Success Factors in Climate Change Adaptation for Smallholder Farmers: A case study in Thai Nguyen province, Vietnam. *Current World Environment*, vol.15 (3), pp. 454-462.