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Women market gardeners and climate change in Kinshasa (DRC): Knowledge, attitudes and practices in the FUNA VALLEY

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ABSTRACT

Urban market gardening supplies a large share of the leafy vegetables consumed in Kinshasa. It is practised mainly by women who farm in flood-prone valleys. Yet little is known about how these women understand and respond to climate change. This study assessed the knowledge, attitudes and practices (KAP) of women market gardeners regarding climate change in the Funa valley, Kinshasa, Democratic Republic of the Congo (DRC). A cross-sectional survey was conducted in November 2025 among 206 randomly selected women (54% of the 384 registered market gardeners), using a structured closed-ended questionnaire; the data were analysed descriptively. Most respondents had heard of climate change (64.7%), had noticed that the climate had changed in recent years (60.6%), had personally experienced its effects (60.5%) and believed that it affects their farming (63.3%). Heavy rainfall (24.9%) and rising temperatures (22.4%) were the most frequently cited signs, and crop flooding was the most frequently cited effect on farming (32.7%). Only 42.8% attributed climate change to human activities alone or combined with natural causes, while 16.9% gave a supernatural explanation.

A majority (61.5%) expressed a positive attitude, but one third (32.7%) could not express any attitude. Between 71.7% and 85.4% reported an adaptation strategy against each of the six climate hazards studied, most often based on traditional know-how. Training was rare: 30.1% had attended training or awareness-raising on climate change and 12.6% agricultural training. Awareness of climate change is therefore widespread among these women, but it rests on lived experience rather than on formal information. Practical training programmes, adapted to women with little schooling and delivered through market gardeners' associations, are needed to turn this awareness into planned adaptation.

Keywords: climate change, urban agriculture, women market gardeners, knowledge attitudes and practices (KAP), adaptation, Kinshasa, Democratic Republic of Congo.

1. INTRODUCTION

Climate change is increasing the frequency and intensity of temperature extremes, heavy rainfall and floods in sub-Saharan Africa, with direct consequences for agriculture, food security and livelihoods [1], [2]. In the Democratic Republic of the Congo (DRC), its effects on agricultural production are already documented, for example on cassava in Kasaï Central [3]. Cities are not spared. In Kinshasa, the capital, with some 17 million inhabitants, repeated floods, heat waves and erosion cause heavy material and human losses [4], [5], [6].

Urban and peri-urban agriculture is an important source of food, income and employment in Kinshasa [7], [8], [9]. Market gardens have developed along the many rivers that cross the city, from the southern hills to the Congo River, notably in the Ndjili, Lukaya, Lukunga and Funa valleys. These humid valley bottoms are fertile and well watered, but they are also the first areas affected by flooding and sand deposition during the rainy season [10], [11]. Market gardening in Kinshasa is practised mainly by women [12], [13]. They depend on it to feed their families and send their children to school, and they face particular difficulties in accessing land, credit, information and training.

The weight of women in this activity is considerable: according to Action contre la Faim, urban agriculture accounted for more than half of female employment in Kinshasa [14]. The income from selling vegetables allows women market gardeners to feed their children, pay for their health care and send them to school, and many of them are the sole heads of their households. Any climate-related crop loss therefore directly affects the food security and well-being of many families. In addition, the rapid urbanization of the hills increases runoff and sand deposition in the valleys, while reducing the land available for farming [12], [15].

How farmers perceive climate change determines whether and how they adapt. In the DRC, studies have described farmers' perceptions of climate variability in Katanga [16], South Kivu [17] and the Kinshasa region [18], [19], [20], as well as the adaptation strategies of Kinshasa market gardeners [21]. The knowledge, attitudes and practices (KAP) framework is widely used to identify gaps between what people know, what they think and what they do, and to design targeted interventions [22], [23]. In Kinshasa, it has recently been applied to riverside populations facing waterborne diseases [24] and to pesticide use by market gardeners [25], but not, to our knowledge, to market gardeners' knowledge, attitudes and practices regarding climate change, nor specifically to women market gardeners.

Available studies show that market gardeners' knowledge of the climate is based mainly on observation and experience rather than on scientific information. In the Kimwenza and Lukaya valleys, Isangu et al. [21] found that the vast majority of market gardeners perceived at least one indicator of climate change, such as rising temperatures, heavy rainfall or declining yields. These perceptions, however, say nothing about attitudes or about how they translate into practices, and they do not distinguish the particular situation of women, who often have more limited access to the media, extension services and training.

The present study fills this gap in the Funa valley, one of the main market-gardening sites in southern Kinshasa. Its objectives were (i) to describe the knowledge, attitudes and practices of women market gardeners regarding climate change, and (ii) to identify the gaps that training and support programmes should address.

2. CONCEPTUAL FRAMEWORK

2.1. Knowledge

Knowledge refers to the body of information, skills and understanding acquired through experience or education. A distinction is usually made between explicit knowledge, which is formalized and easy to share (documents, training), and tacit knowledge, which stems from experience and is difficult to formalize. A distinction is also made between empirical knowledge, produced by direct observation of the environment, and scientific knowledge, validated by research methods. In the field of climate, empirical knowledge makes it possible to notice changes (more rain, more heat), whereas

scientific knowledge makes it possible to understand their causes and predict their evolution.

2.2. Attitudes

An attitude is a state of mind of a person or a group towards an object, an action or a phenomenon [26]. It comprises a cognitive dimension (what one thinks), an affective dimension (what one feels) and a conative dimension (what one is prepared to do). With regard to climate change, a positive attitude consists in recognizing the phenomenon as a serious problem that deserves action; a negative or indifferent attitude consists in minimizing it or considering it as temporary or beyond human reach.

2.3. Practices

Practice refers to the concrete application of knowledge: the actions, behaviours and habits of a community in the face of a phenomenon. In a KAP survey, practices may be reported by respondents, observed directly or measured. In agriculture, climate change adaptation practices concern water and soil management, the choice of crops and varieties, the cropping calendar and crop protection. They differ from mitigation measures, which aim to reduce the causes of climate change.

2.4. The KAP model and its limitations

The KAP model is based on the idea that knowledge influences attitudes, which in turn guide practices. It makes it possible to quickly identify gaps between what people know, think and do, and to target interventions [22], [23]. In Kinshasa, it has been applied to the prevention of waterborne diseases [24] and to pesticide use [25]. The model nevertheless has limitations: responses are self-reported, the relationship between knowledge and practices is not always linear, and practices may precede knowledge, particularly when they are passed on through tradition [22]. These limitations are taken into account in interpreting our results.

3. MATERIALS AND METHODS

3.1. Study area

The Funa River is a tributary of the Congo River. It rises in the Kindele neighbourhood, Mont-Ngafula commune (about 15°17′51″ E, 4°25′03″ S; 329 m above sea level), and flows north through the communes of Makala, Kalamu and Limete. Its watershed covers 69 km² with a perimeter of 49 km [27]. Kinshasa has a humid tropical climate, with a rainy season of about eight months (September to May), interrupted by a short dry season in January–February, and a long dry season from June to August. The valley is devoted mainly to market gardening, and access to land is a recurring problem there [15]. The women market gardeners are grouped in the Association des Maraîchers de la Funa Kimwenza (AMFK).

grow leafy and fruit vegetables, often intercropped: sweet potato leaves, amaranth, roselle (sorrel), bitter nightshade, Malabar spinach (basella), cassava leaves, okra, eggplant, tomato, cabbage and chilli pepper. Activity is most intense in the dry season, when floods recede (Figure 1).

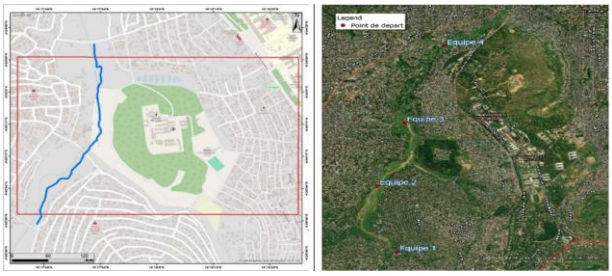


Figure 1: The Funa market-gardening valley, Kinshasa: (a) location of the valley; (b) survey area and starting points of the four survey teams

3.2. Study design, population and sampling

A cross-sectional quantitative survey was conducted. The study population comprised 384 market gardeners registered at the Funa site by the agricultural services. The minimum sample size was calculated using Yamane's formula [28]:

$$n = N / (1 + N \cdot e^2) \quad (1)$$

where n is the sample size, N the population size (384) and e the margin of error (0.05). Equation (1) gives a minimum of 196 respondents. Respondents were selected by simple random sampling among the women working at the site. The survey took place in November 2025, at the beginning of the rainy season, when most women market gardeners were present every day to sow, tend their plots and protect them against heat, rising water and sand deposition. This made it possible to interview 206 women, i.e. 54% of the registered market gardeners. Only women were interviewed, because they make up the vast majority of market gardeners at the site and are considered particularly vulnerable to climate hazards.

3.3. Data collection

Data was collected using a structured paper questionnaire of 22 closed-ended questions, administered face to face at the site by four teams of enumerators. It comprises four sections:

- **Socio-demographic characteristics and training:** commune of residence, age group, marital status, level of education, participation in training or awareness-raising on climate change, and participation in other agricultural training.
- **Knowledge:** knowledge of climate change, perceived signs, personal experience of its effects, perceived change in recent years, perceived causes, and perceived effects on Kinshasa and on farming.
- **Attitude:** the attitude to adopt towards climate change.
- **Practices:** the main strategy used against each of the following six hazards: heat waves, floods, erosion and sand deposition, lengthening of the dry season, soil degradation, and crop diseases and pests.

Each question offered the answer "I don't know".

3.4. Data analysis

Data was entered and analysed with IBM SPSS Statistics 20. Frequencies and percentages were calculated for all variables. Percentages are reported on valid responses, and the number of valid responses is indicated for each question in the tables. For practices, a respondent was considered to have an adaptation strategy against a hazard when she cited a strategy other than "I don't know".

3.5. Ethical considerations

The study was conducted as part of a master's degree in environmental science at the European University of Lefke. Each questionnaire began with an introduction presenting the researcher, the university and the purpose of the study. Participation was voluntary, no names were recorded and the data were analysed anonymously.

4. RESULTS

4.1. Socio-demographic characteristics

More than half of the respondents (56.3%) lived in Mont-Ngafula, the commune where the market-gardening site is located, followed by Lemba (15.5%) and Makala (13.6%) (Table 1). Few women came from more distant communes, because transport is expensive. The women market gardeners were mostly middle-aged adults: 41.7% were between 41 and 50 years old, and only 11.1% were under 30. More than half (54.9%) lived without a spouse (single, divorced or widowed). Nearly one woman in five (18.1%) had never attended school, and 36.3% had not gone beyond primary level; 18.6% had a university degree or vocational training.

Table 1: Socio-demographic characteristics and training of the women market gardeners surveyed (N = 206)

Variable	n	%
Commune of residence (n = 206)		
Mont-Ngafula	116	56.3
Lemba	32	15.5
Makala	28	13.6
Selembao	18	8.7
Matete	7	3.4
Ngaliema	3	1.5
Other	2	1.0
Age group, years (n = 206)		
< 25	12	5.8
25–30	11	5.3
31–35	16	7.8
36–40	24	11.7
41–45	39	18.9
46–50	47	22.8
51–55	26	12.6
56–60	17	8.3
> 60	14	6.8
Marital status (n = 204)		
Married	78	38.2
Divorced	41	20.1
Single	39	19.1
Widowed	32	15.7
Other	14	6.9
Level of education (n = 204)		

Variable	n	%
No schooling	37	18.1
Primary	37	18.1
Secondary	20	9.8
State diploma (end of secondary school)	72	35.3
Bachelor's degree (licence)	23	11.3
Vocational training	15	7.4
Training or awareness-raising on climate change (n = 206)		
Yes	62	30.1
No	106	51.5
Don't know	38	18.4
Other agricultural training (n = 206)		
Yes	26	12.6
No	180	87.4

Percentages are calculated on valid responses.

Training was rare. Fewer than one woman in three (30.1%) had attended training or an awareness-raising session on climate change, and only 12.6% had attended other agriculture-related training (Table 1). During the interviews, several women confused one-off awareness campaigns, without follow-up, with genuine training.

4.2. Knowledge of climate change

Nearly two thirds of the women had heard of climate change (64.7%), had noticed that the climate had changed in recent years (60.6%) and had personally experienced its effects (60.5%) (Table 2). Heavy rainfall (24.9%) and rising temperatures (22.4%) were the most frequently cited signs, followed by more frequent floods (13.9%); 30.8% could not cite any sign.

Table 2: Knowledge of climate change among women market gardeners

Question and response	n	%
Has heard of climate change (n = 204)		
Yes	132	64.7
No	72	35.3
Has noticed that the climate has changed in recent years (n = 203)		
Yes	123	60.6
No	40	19.7
Don't know	40	19.7
Has personally experienced the effects of climate change (n = 205)		
Yes	124	60.5
No	24	11.7
Don't know	57	27.8
Main sign of climate change (n = 201)		
Increase in heavy rainfall	50	24.9
Increase in extreme heat	45	22.4
More frequent floods	28	13.9
Longer dry season	11	5.5
More frequent landslides and erosion	5	2.5
Don't know	62	30.8
Main cause of climate change (n = 201)		
Human activities	61	30.3
Natural causes	31	15.4
Natural causes and human activities	25	12.4
Wrath of God	23	11.4
End of the world	8	4.0
Evil spirits or genies	3	1.5
Don't know	50	24.9

Percentages are calculated on valid responses.

Views on the causes of climate change were divided (Table 2). Human activities were cited alone by 30.3% of the women, and together with natural causes by a further 12.4%, i.e. 42.8% in total, which corresponds to the scientific consensus. Natural causes alone were cited by 15.4%. One woman in six (16.9%) gave a supernatural explanation: the wrath of God (11.4%), the end of the world (4.0%) or evil spirits (1.5%). A quarter (24.9%) did not know the cause.

4.3. Perceived effects on the city and on market gardening

Most respondents (64.1%) knew that climate change affects Kinshasa, and 63.3% believed that it affects their own farming (Table 3). For the city, the main effects cited were increased heat during the rainy season (25.0%) and rivers overflowing (24.5%). For their crops, flooding was by far the most frequently cited effect (32.7%), followed by effects on the quality and growth of vegetables (11.1%), disruption of the cropping calendar (8.8%) and an increase in plant diseases (8.2%). Floods and sand deposition affect the valley every rainy season.

Table 3: Perceived effects of climate change on Kinshasa and on market gardening

Question and response	n	%
Knows that climate change affects Kinshasa (n = 198)		
Yes	127	64.1
No	20	10.1
Don't know	51	25.8
Main effect on Kinshasa (n = 192)		
Increased heat during the rainy season	48	25.0
Rivers overflowing	47	24.5
Dry season less and less cool	29	15.1
Increased erosion on the hills	8	4.2
Very heavy rainfall	7	3.6
Don't know	53	27.6
Believes that climate change affects her farming (n = 199)		
Yes	126	63.3
No	22	11.1
Don't know	51	25.6
Main effect on her farming (n = 171)		
Crop flooding	56	32.7
Effect on vegetable quality and growth	19	11.1
Disruption of the cropping calendar	15	8.8
More plant diseases	14	8.2
Low yields	11	6.4
Production loss	10	5.8
Sand burial of crops	8	4.7
Insect proliferation	1	0.6
Don't know	37	21.6

Percentages are calculated on valid responses.

4.4. Attitudes towards climate change

Most of the women (61.5%) expressed a positive attitude: 22.9% considered climate change a priority to be addressed, 21.5% a problem that deserves particular attention, and 17.1% a dangerous phenomenon that must be controlled. Only 5.9% considered it unimportant or temporary. However, one third of the respondents (32.7%) could not express any attitude (Table 4).

4.5. Adaptation practices

Between 71.7% and 85.4% of the women reported a strategy against each of the six hazards studied (Table 4). Erosion and sand deposition was the hazard against which respondents most often had no strategy (28.3%). The strategies cited relied mainly on traditional know-how: regular watering against heat, raised beds against floods, small dikes against erosion and sand deposition, and the use of ash or adapted varieties against pests.

Table 4: Attitudes towards climate change and adaptation practices

Question and response	n	%
Attitude to adopt towards climate change (n = 205)		
A priority that must be addressed	47	22.9
A problem that deserves particular attention	44	21.5
A dangerous phenomenon that must be controlled	35	17.1
Unimportant	6	2.9
A temporary natural phenomenon	6	2.9
Don't know	67	32.7
Reports at least one adaptation strategy against:		
Soil degradation (n = 199)	170	85.4
Lengthening of the dry season (n = 204)	171	83.8
Floods (n = 203)	164	80.8
Heat waves (n = 205)	165	80.5
Diseases and pests (n = 203)	162	79.8
Erosion and sand deposition (n = 198)	142	71.7

Percentages are calculated on valid responses.

4.6. Summary of KAP indicators

Table 5 summarizes the main indicators of the survey, distinguishing for each the share of favourable responses and the share of "I don't know" responses. On average, 64.0% of responses to the nine knowledge indicators were favourable, compared with 61.5% for attitude and 80.3% for practices. In other words, the women report an adaptation strategy more often than they report knowing about the phenomenon or having a clear attitude towards it.

Table 5 also highlights the weight of "I don't know" responses. For the knowledge questions that offered this answer, it accounted on average for 25.5% of responses, i.e. one woman in four. It reached 30.8% for the signs of climate change and 32.7% for attitude, but only 19.7% on average for practices. Uncertainty is therefore greater about what climate change is than about what to do in practice in the face of a hazard.

Table 5: Summary of knowledge, attitude and practice indicators (%)

Indicator	n	Favourable	Don't know	Negative
Knowledge				
Has heard of climate change	204	64.7	–	35.3
Has noticed a change in the climate	203	60.6	19.7	19.7
Has experienced the effects	205	60.5	27.8	11.7
Cites a sign of climate change	201	69.2	30.8	–
Cites a human cause (alone or combined)	201	42.8	24.9	32.3
Knows that Kinshasa is affected	198	64.1	25.8	10.1
Cites an effect on Kinshasa	192	72.4	27.6	–
Believes her farming is affected	199	63.3	25.6	11.1
Cites an effect on her farming	171	78.4	21.6	–
Knowledge average		64.0	25.5	
Attitude				
Positive attitude	205	61.5	32.7	5.9
Practices (at least one strategy against…)				
Heat	205	80.5	19.5	–
Floods	203	80.8	19.2	–
Erosion and sand deposition	198	71.7	28.3	–
Lengthening of the dry season	204	83.8	16.2	–

Indicator	n	Favourable	Don't know	Negative
Soil degradation	199	85.4	14.6	–
Diseases and pests	203	79.8	20.2	–
Practices average		80.3	19.7	

Favourable: response reflecting knowledge, a positive attitude or the existence of a strategy. Negative: opposite response (no, non-human cause, negative attitude). The average of "don't know" responses for knowledge covers the eight questions that offered this answer. –: not applicable.

5. DISCUSSION

This study is the first KAP assessment of climate change among women market gardeners in Kinshasa. It shows widespread but experience-based awareness: about two thirds of the women know about climate change, have noticed it and feel its effects on their crops, while fewer than one in three has ever attended training or awareness-raising on the subject.

5.1. Knowledge drawn from experience

The most frequently cited signs and effects, namely heavy rainfall, floods and heat, are those that the women experience directly every rainy season at the bottom of the valley. Similar perceptions have been observed among farmers in Maluku [19], among other Kinshasa market gardeners [18], [20], in the Kimwenza and Lukaya valleys [21] and in South Kivu [17]. Phanzu et al. [20] found that rising temperatures were the most noticed sign, whereas in the Funa valley rainfall and floods come first. This difference is probably explained by the exposure of valley-bottom plots to river overflows and sand deposition, which our earlier work in the Ndjili and Makoko valleys had also highlighted [10], [11]. Experience-based knowledge is valuable, but it does not extend to the causes of the phenomenon or its expected evolution. As Phanzu et al. [20] observed, market gardeners hear about climate change mainly through the media rather than through training.

Table 6 compares our results with those of Isangu et al. [21] in the neighbouring Kimwenza and Lukaya valleys. The two studies do not measure exactly the same thing: we asked for the main sign or main effect, whereas Isangu et al. recorded all perceived indicators, with multiple responses possible. The order of importance is nevertheless instructive: heat dominates in Kimwenza and Lukaya, whereas heavy rainfall comes slightly ahead in the Funa, which confirms the weight of flooding in this valley.

Table 6: Perceived climate change indicators in the Funa valley and in the Kimwenza and Lukaya valleys (%)

Indicator	Funa, main sign or effect	Kimwenza and Lukaya [21]
Rising temperatures	22.4	76
Heavy rainfall	24.9	60
Floods	13.9	13
Declining yields	6.4	86
Pest proliferation	0.6	81
At least one indicator perceived	69.2	84

Funa: main sign (Table 2) or main effect on farming (Table 3), single response. Kimwenza and Lukaya: all perceived indicators, multiple responses possible.

5.2. A divided understanding of causes

Fewer than half of the women attributed climate change to human activities, alone or combined with natural causes, and one in six gave a supernatural explanation. Religious and fatalistic interpretations of climate hazards can reduce the feeling that adaptation is possible or worthwhile. They did not, however, prevent most women from reporting adaptation strategies. Information campaigns should therefore explain the causes in terms that make sense locally, for example through religious and community leaders, rather than simply contradicting existing beliefs.

The weight of these explanations also stems from the lack of formal information. In the field, the women reported having heard about climate change mainly through informal channels, such as the media, word of mouth, radio, mobile phones or social networks, and rarely through training. In this context, religious interpretations offer a readily available and shared framework of understanding. The fact that a quarter of the women do not know the cause of the phenomenon shows that there is considerable room for clear, adapted and repeated information.

5.3. Attitudes and practices

Most women considered climate change a serious problem, and a large majority reported at least one strategy against each hazard. These strategies rely mainly on traditional knowledge passed down from generation to generation, as has also been observed in Kimwenza [29] and in other Kinshasa valleys

[21], [10], [11]. The third of respondents who could not express any attitude, and the quarter with no strategy against erosion and sand deposition, identify the groups most in need of support. Some women may not have fully understood the attitude question, which should be reworded in future surveys.

The summary in Table 5 shows that practices are more widespread than knowledge and attitudes. This result runs counter to the linear logic of the KAP model, according to which knowledge precedes practice. It is explained by the nature of the knowledge involved: the women's strategies are passed down from generation to generation and learned on the plot, without going through formal knowledge of climate change. The women "know how" before they "know why". This gap is not a weakness in itself, but it limits the women's capacity to anticipate new or more intense hazards, for which traditional practices are no longer sufficient.

5.4. The lack of training

The very low proportion of women who had received training, especially in agriculture (12.6%), is a major finding. The observed confusion between awareness campaigns and genuine training suggests that the few interventions carried out so far have been short and without follow-up. In the neighbouring Kimwenza area, Tshimanga and Azidi [29] showed that market gardening relies more on practical experience than on schooling. This argues for practice-based training delivered on the plots, rather than classroom-style information sessions.

5.5. Implications

Three implications follow. First, training must be adapted to women with little schooling: practical, in local languages, delivered on site and through the AMFK association. Second, it must explain the causes of climate change and the expected evolution of rainfall and temperatures, not only immediate responses. Third, local traditional practices should be documented and strengthened rather than replaced, and complemented by low-cost techniques such as mulching, agroforestry, grass strips and better drainage.

In concrete terms, a training programme for the Funa women market gardeners could comprise four components. The first would cover agroecology and adaptation techniques: mulching to conserve soil moisture, organic fertilizers, composting, intercropping and crop rotation. The second would cover water management: rainwater harvesting and storage, water-saving irrigation and plot drainage. The third would cover crop protection, favouring biological methods and the safe use of pesticides. The fourth would cover climate information: understanding the causes of climate change and using forecasts and warnings of heavy rainfall.

This programme should build on the public agricultural extension and urban horticulture services, in line with the DRC's National Adaptation Plan, and be relayed by the AMFK. Demonstration plots, exchange visits between valleys and local agricultural fairs would make it possible to disseminate good practices at low cost. Finally, training should be followed up over time, with an evaluation of its effects on knowledge and practices, to avoid repeating the one-off campaigns without follow-up that the women described.

5.6. Limitations

This study has several limitations. Its analysis is descriptive: the links between socio-demographic factors, training and KAP were not tested statistically and should be studied in future work. Its cross-sectional design does not allow conclusions about cause-and-effect relationships. It covers a single valley, which limits generalization to other market-gardening sites in Kinshasa. The data are self-reported, and practices were neither observed nor measured on the plots. Attitude was measured by a single question. Finally, the survey took place at the beginning of the rainy season, which may have increased the prominence of floods in the responses.

CONCLUSION

Women market gardeners in the Funa valley are largely aware of climate change and its effects on their crops, mainly through their own experience of floods, heavy rainfall and heat. Their understanding of the causes remains limited, one third cannot express any attitude towards the phenomenon, and very few have received training. Strengthening these women's adaptive capacity requires practical training programmes, delivered on site through their association, that build on their traditional knowledge and explain the causes and expected evolution of climate change. Future research should test the factors associated with KAP, compare several valleys, include male market gardeners and combine surveys with field measurements of adaptation practices and yields.

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