A.C.4; D.C.4.1

Local surveys for forest managers, nurseries, conservation managers

Compiled by

Reneema Hazarika

SUSTREE- Austrian Research Centre for Forests, BFW, Vienna, Austria

Contents

Introduction

Utilizing the intrinsic genetic variation within a tree species is an option for adapting forests to climate change (Bolte et al., 2009; Lindner et al., 2010).In practice, utilizing such genetic variation means identifying populations or provenances adapted to the future climatic conditions. Annually, approximately 900 million seedlings of the major tree species are planted in Central Europe (CE), offering an opportunity to implement adaptive management by matching adapted forest reproductive materials (FRM) and suitable planting locations.

Apart from the guidelines at the EU level, such as the EU Council Directive, 2000 (European Union 2000), national level regulations such as the nationally defined *region of provenances* guide the utilization of FRM in majority of the countries. Climate change is likely to cause substantial changes in growing conditions within and beyond these regions, making them impractical in the future. Ample scientific evidence exist that seed sources adapted to future conditions may not necessarily be of local origin (Aitken & Whitlock, 2013; Chakraborty et al., 2015). Therefore, it is crucial to focus on policies that enable countries to sources planting materials from outside their borders, if such materials are optimum for future climate. This requires knowledge of the perceptions of the practitioners on issues such as effects of climate change, awareness about genetic diversity, current practices in afforestation and trade and utilization of planting materials.

The SUSTREE project brings together experts on forest provenance research and breeding from eight institutions and six countries (i.e. Austria, Germany, Hungary, Czech Republic, Poland and Slovakia) of Central Europe (CE). The objective of this collaboration is to discuss strategies for cross-boundary transfer of FRMs in order to support the adaptation of forests under ongoing climate change. An important step in this direction was an online survey conducted in 2017 among forest managers, conservation managers and forest nurseries in the six project-partner countries. With more than 800 responses, the aim of this survey was to analyze:

I. the perceptions on the effects of climate change on forests,
II. perceptions on the importance of afforestation to promote ecosystem stability under climate change and current practices in selecting FRMs

III. perceptions on the importance of genetic diversity for selecting FRMs and the influence of existing national and European legislations on utilizing FRMs under climate change (Table A4)

Materials and methods

Structured questionnaires (Bryman, 2012) were used to collect primary data from the six SUSTREE partner countries of Central Europe. Three questionnaires (Table A1, A2, A3 in Appendix) were designed, one for each of the three groups of respondents namely forest managers (FM), conservation managers(CM), and nurseries (NR). This survey was launched online for 4 months from May until August 2017. All the three questionnaires were translated in the six local languages of the partner countries i.e. English, German, Hungarian, Czech Republic, Polish and Slovak.

In addition to online access, for a wider dispersal of the survey, the questionnaires were also disseminated through email-lists and social media, targeting organizations and forest SMEs, involved in the forestry sector in the six earmarked countries triggering an exponential non-discriminative snowball sampling (Goodman, 1961)also known as chain referral sampling. The snowball sampling method involves primary data sources nominating another potential primary data sources to be used in the research. In other words, snowball sampling method is based on referrals from initial subjects to generate additional subjects. Therefore, when applying this sampling method, members of the sample group are recruited via chain referral. This method is a non-probability (non-random) sampling method in which project partners shared the survey link with the associated partners. Associated partners then distributed this survey to various stakeholders thus creating the "snowball effect". The questions were mainly multiple choice and the participants had the option of choosing one or more relevant options to certain questions or also to not respond to certain questions according to their convenience. Some respondents i.e. from Austria, Hungary and Poland sent hand-filled forms through the post office whereas others via email.

The results from the survey were first assessed through exploratory analyses. This was followed by analyses of the statistical differences in frequencies of the responses with G-test (repeated-

goodness-of-fit). Spearman's correlation analysis was used to test the correlation between responses for related questions.

Two types of analyses were taken in consideration according to the relevance of the responses i.e. between all three groups of respondents for individual countries (e.g. CM+FM+NR of Austria) and across each group of respondents across all countries (e.g. only the CM of all countries).

The analyzed responses are grouped under the following heads

i. perceptions on the likely effects of climate change,
ii. afforestation for promoting stability of forest ecosystem under climate change and
iii. the perceptions of genetic diversity and implications of national and regional policies on trade and utilization of FRMs.

Results

In total 815 participants from six countries of CE, participated in the survey (Table 1). The number of participants varied between the three groups of respondents, the Conservation managers (CM), Forest managers (FM)and Nurseries(NR) as well as between the countries. Poland and the Czech Republic had the highest and lowest number of respondents respectively among all respondents (Table 1).

Table 1: Details of the participants in the local survey along with the basic data on forest ownership.

Countries	**Respondents**				***Ownership (% of total geographic area)***_for sources see reference_		
	Forest managers (FM)	**Conservation managers (CM)**	**Nurseries (NR)**	**Total**	**Approx. Forest Area (% of geographic area)**	**Public (% of total forest area)**	**Private (% of total forest area)**
Austria	107	12	19	138	46.2	18	82
Czech Republic	22	5	10	37	34.5	78	22
Germany	119	7	8	134	32	45	48
Hungary	19	1	31	51	29.4	81	19
Poland	192	17	166	375	21.45	58	42
Slovakia	50	7	23	80	40.1	56	43.2
Total	510	49	257	815	46.2	18	82

Perceptions on the likely effects of climate change

Climate change was perceived to influence businesses and operational areas (percentage of yes ranging from 76% – 86 %), across all the three groups of respondents (Fig. 1) in all the 6 countries (Table 2). However, the perception varied between countries (Table 2). For example, the percentage of positive responses(percentage of yes out of total responses) across all the three groups in Austria, Germany Hungary, and Poland were significantly higher compared to the Czech Republic and Slovakia.

The positive responses when tested for significance across all managers (CM, FM, NR) of each country individually (for example, number of CM+FM+NR of Austria etc.) shows no significant difference in opinion ($p>0.05$) But on testing across individual groups of managers across all countries, (for example, all CM from all six countries etc.), the respondents from nurseries shows significant difference of perception

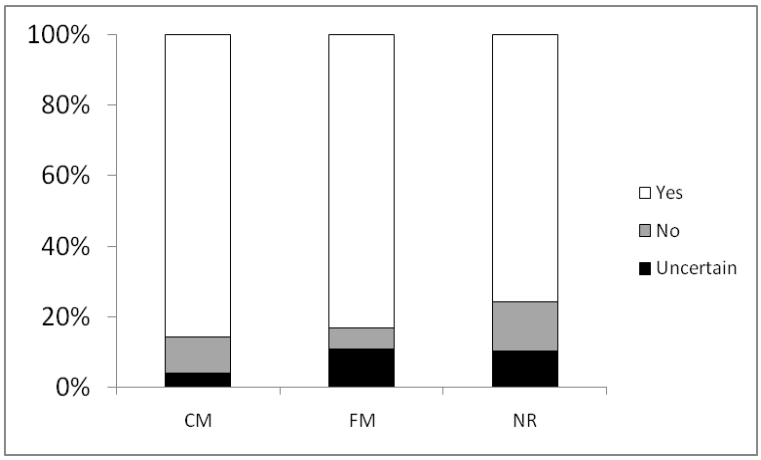

Fig. 1 Response of CM, FM and NR combined across countries on their perception if climate change is the likely to affect their operational areas and business.

The perceived effects of climate change by the three groups of respondents were characterized by describing the nature of the changes expected (Table A1, A2, A3).

74 percent of the CM (n=49)think that their conservation objectives will not change due to climate change whereas 62% of the FM (n=433) think that their management objectives will be difficult to reach(Table A5, A6 in Appendix).

Table 2. Differences in perception of the conservation managers (CM), forest managers (FM) and Nurseries (NR) on the effects of climate change on their respective operational areas and businesses. Significance differences were tested with G-test (goodness of fit; $p<0.05$). n = Number of respondents for that specific question (total number of respondents may vary for each question as every participant might/might-not respond to every question)

Question	**Respondents**	**n**	**Responses (% of yes)**						***p- value***
			Austria	**Czech Republic**	**Germany**	**Hungary**	**Poland**	**Slovakia**	
Do you expect changes in your conservation area or forest area or business due to climate change?	CM	49	100	40	100	100	88	71	<0.00
	FM	510	95	82	93	100	69	84	>0.05
	NR	257	95	70	100	97	69	78	<0.00

Among the NR (n=140) respondents across all countries, 36% thinks that climate change will result in “increasing demand for other provenances with higher resistance to climate extremes or new pests /diseases” and 27%perceived “increasing demand for other tree species such as changes from conifers to broadleaves”(Fig. 2)

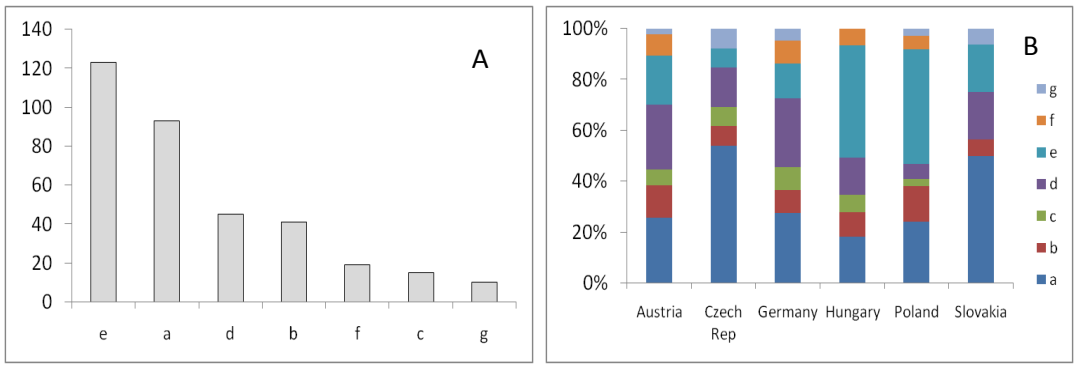

Fig. 2 (A) Total number of respondents from nurseries on their perception of the expected changes in their business due to climate change. B) Country wise variation in responses of nurseries.

a) Increasing demand for other tree species; change from conifers to broadleaves
b) Increasing demand for forest reproductive material
c) Decreasing demand for forest reproductive material
d) Increasing demand for forest non-native tree species (e.g. Douglas fir, oak)
e) Increasing demand for other provenances with higher resistance to climate extremes or new pests /diseases
f) Increasing demand for provenances from outside the country
g) Others

Afforestation for promoting stability of forest ecosystem under climate change

Afforestation is widely promoted, as an adaptive measure to promote stability of forests under climate change (Bolte et al. 2009). Therefore, the CM and FM respondents were asked if they consider planting and afforestation activities to increase forest stability in climate change and related questions on planting materials for afforestation (Table A5, A6, A7 in Appendix).

The CM (n=49) were somehow conservative in their perception as the number of respondents who believe that afforestation is likely to promote forests' stability under climate change was observed to be not significantly high compared to those who do not believe or were uncertain (Fig. 3, Table 3). The responses of FM(n=507) tend to show a different trend in their perceptions whereby majority (63%- 96%, Table 3) considered afforestation activities to be an important option for promoting stability of forest ecosystem under climate change.

Table 3. Differences in perception of the conservation managers (CM), forest managers (FM) and Nurseries (NR) on the role of afforestation for promoting stability of forest ecosystem under climate change. Significance differences were tested with G-test (goodness of fit; $p<0.05$). n = Number of respondents for that specific question (total number of respondents may vary for each question as every participant might/might-not respond to every question)

Question	Respondents	n	Responses (% of yes)						*p-value*
			Austria	Czech Republic	Germany	Hungary	Poland	Slovakia	
Do you consider planting and afforestation activities in order to improve forest ecosystem services, in particular, to increase forest stability in climate change?	CM	49	50	100	43	100	65	57	<0.00
	FM	507	95	95	97	63	83	96	<0.00

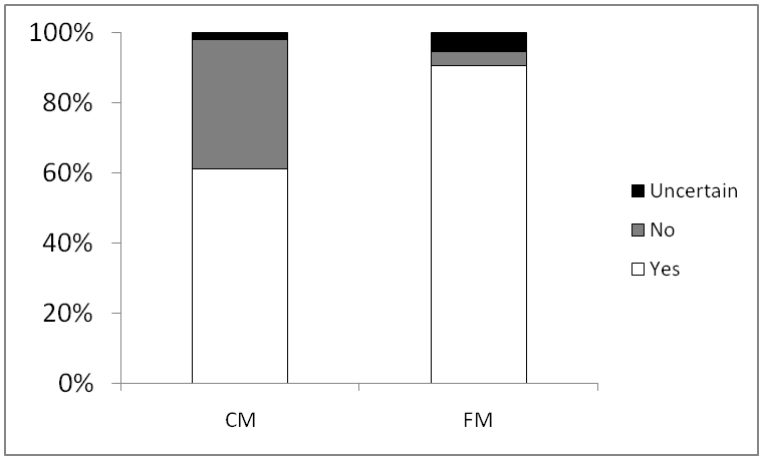

Fig. 3 The response of Conservation manager and Forest managers if they consider afforestation activities to promote stability of forest ecosystem services under climate change

Planting materials utilized in afforestation are usually obtained by considering national provenance regions. The survey revealed that in case of CM (n=28), 29-100% and FM (n=417), 98-100% of the respondents take national provenance regions into account while selecting FRMs for

afforestation (Table 4). The share of the respondents taking national provenance regions into account varies significantly ($p < 0.05$) between countries in case of CM, whereas country specific variations do not exist in case of FM (Table 4). Use of foreign FRMs might be crucial under climate change if such planting materials or provenances are adapted to future conditions (Chakraborty et al. 2015). However, only a few of the CM (14-33%) and FM (4 -18%), use FRMs of foreign origin (Table 4). This similar trend was also observed in case of the likelihood of using or trading of FRMs of foreign origin in the future by the same group of respondents (Table 4)

Table 4. Differences in perception of the conservation managers (CM), forest managers (FM) and Nurseries (NR) on the role of utilization of FRMs for afforestation. Significance differences were tested with G-test (goodness of fit; $p<0.05$). n = Number of respondents for that specific question (total number of respondents may vary for each question as every participant might/might-not respond to every question)

Question	**Respondents**	**n**	**Responses (% of yes)**						***p- value***
			Austria	**Czech Republic**	**Germany**	**Hungary**	**Poland**	**Slovakia**	
Do you take national regions of provenance into account when selecting the planting material?	CM	49	58	100	43	100	53	29	<0.00
	FM	447	98	100	97	100	100	98	>0.05
Have you ever used planting material in this area from other regions outside your country?	CM	49	33	0	29	0	0	14	<0.00
	FM	496	18	14	22	19	2	4	<0.00
Would you use planting material from other regions outside your country?	CM	49	25	20	0	0	12	29	<0.00
	FM	503	24	23	43	26	13	24	<0.00
Do you think you will increasingly sell reproductive material to foreign clients?	NM	256	26	0	13	13	26	0	<0.00

Among the participants who responded positively about the importance of afforestation to stabilize forests under climate change, 50% of the CM (n=28), and 65% of FM (n=417) says they select reproductive materials (seeds, seedlings and other planting materials) from their own forests. Again CM 17% and FM 54% of the rest of this group says that they predominantly use afforestation materials from the nearby nurseries (Fig. 4A and 4B).

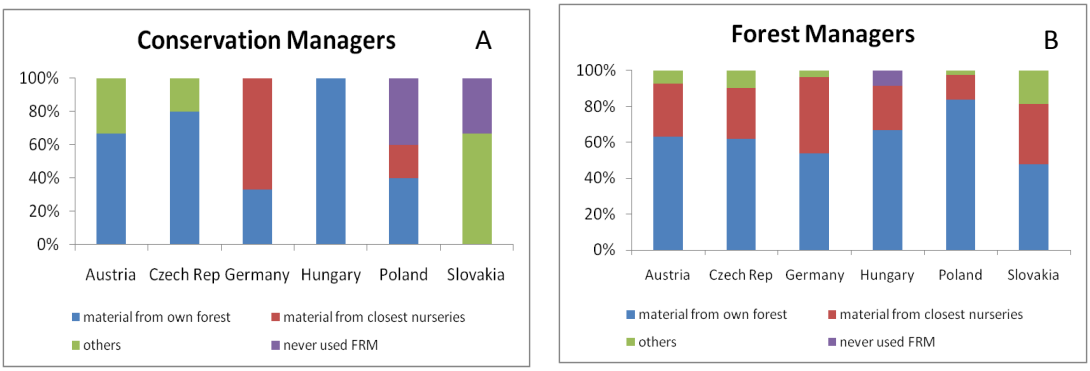

Fig. 4 Choice of the source of planting materials for Conservation(A) and forest managers (B) who think afforestation as an important option for promoting stability of forest ecosystem under climate change.

Unavailability of domestic seeds or seedlings is observed to be the main reason for using or selling FRMs of foreign origin for all the respondents followed by use of foreign FRMS if such materials are of genetically better quality (Fig. 5).

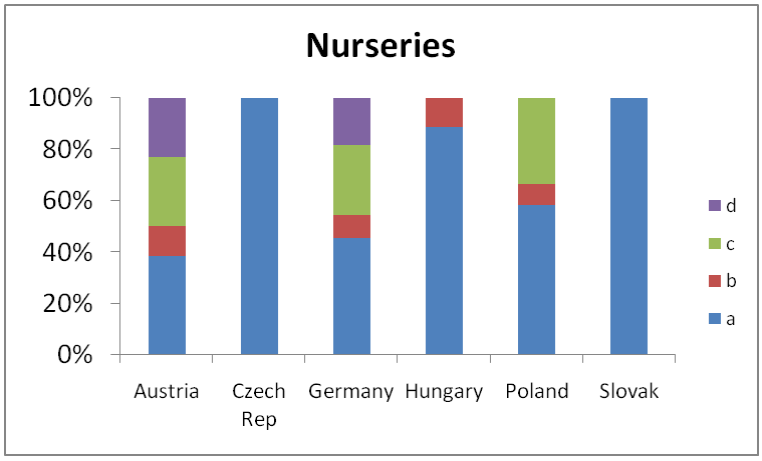

Fig. 5 Reasons of NR respondents for using foreign FRMs. Here: a =Unavailability of domestic seeds/seedlings; b = Less expensive reproductive material; c= Better genetic material (i.e. better growth, stem form etc.); d= Better adaption to expected climate conditions

Regarding the importance of conservation activities, among(n=555) 47% among CM and FM across all countries, considered planting tree provenances fit- for-climate-change to be “important” and 33% of them considered it to be a “very important” aspect for conservation. Following the same trend, regarding keeping the same tree composition of an area, is also found to be “important” by 39% of managers and “very important” by 35 % whereas 19% of the managers found it to be a “less important” aspect for conservation (Table A5, A6, A7 in Appendix).

Perceptions of genetic diversity and implications of national and regional policies on trade and utilization of FRMs

Majority of respondents(CM=100%, FM=94-100%)across all countries (Table 5) considered genetic diversity to be “important”. In addition, 41% -100 % of the CM and 76-100% of the FMs consider incorporating genetic diversity in the management plan (Table 4).

On the other hand, a mixed trend was observed in the level of awareness on genetic diversity among these respondents, 14 -100% in case of CM and 44 - 84 % in case of FM. The level of awareness was observed to vary significantly between countries as well for both CM and FM (Table 5)

Table 5. Differences in perception of the conservation managers (CM), forest managers (FM) and Nurseries (NR) on the role the importance and awareness level of forest genetic diversity used for afforestation. Significance differences were tested with G-test (goodness of fit; $p<0.05$).n = Number of respondents for that specific question (total number of respondents may vary for each question as every participant might/might-not respond to every question)

Question	Respondents	n	Responses (% of yes)						p-value
			Austria	Czech Republic	Germany	Hungary	Poland	Slovakia	
Do you consider genetic diversity of forest trees to be important?	CM	49	100	100	100	100	100	100	<0.00
	FM	510	100	100	100	100	96	94	>0.05
Do you consider forest genetic diversity in your management plans?	CM	49	83	100	71	100	41	57	<0.00
	FM	510	81	91	84	79	87	76	>0.05
Do you feel you are well informed about forest genetic diversity?	CM	49	42	40	43	100	53	14	<0.00
	FM	510	50	73	44	53	84	34	<0.00

The utilization and trade of FRM for afforestation and the genetic diversity in European countries is regulated by national and European legislation such as the EU Council Directive (European Union 2000). Only 16-48 % of the FMs and 20-75 % of the NRs feel that national seed transfer legislations are well- adapted for climate change (Table 6). This result actually shows that majority of the respondents are either uncertain (FM=41 %, NR=38%) or don't agree (FM =25%, NR=28%) that seed transfer and genetic diversity is regulated by the national legislation and are adapted to climate change.

Table 6. Differences in perception of the conservation managers (CM), forest managers (FM) and Nurseries (NR) on the role the role national and European legislation on seed transfer for selecting FRMs for afforestation under climate change. Significance differences were tested with G-test (goodness of fit; $p<0.05$). n = Number of respondents for that specific question (total number of respondents may vary for each question as every participant might/might-not respond to every question)

Question	Respondents	n	Responses (% of yes)						p-value
			Austria	Czech Republic	Germany	Hungary	Poland	Slovakia	
Do you think the national legislation on seed transfer is well adapted in times of climate change?	FM	510	28	18	34	16	36	48	<0.00
	NR	253	39	70	75	20	31	35	<0.00
Do you think the European legislation on seed transfer is well adapted in times of climate change?	FM	498	9	5	14	5	11	10	>0.05
	NR	257	37	30	38	16	10	22	<0.00

A similar trend was observed regarding the European legislation on seed transfer as well, where only 5-14 % of the FMs and 10-38 % of the NRs feel that such legislation are adapted for climate change (Table 6). On the other hand, the majority of the respondents either don't agree (FM=20, NR=17%) or are uncertain (FM=64% and NR=72%) about this issue. Although there is no significant difference among the positive and negative responses among the participants across all the countries ($p>0.05$), Hungary ($p=0.003$) and Poland ($p= 0.01$) does show a significant difference in their responses.

Association between the responses

Analyses of the responses showed that the CM and FM respondents who perceived that climate change is likely to influence their conservation and forest areas, do not necessarily think that afforestation will improve the forests stability under climate change (Spearman's correlation $r=0.35$, $p>0.05$). Also, regarding the use of foreign FRMs in future, all the CM, FM and NR respondents who had perceived that Climate Change is likely to influence their conservation area

and forest areas and business, do not necessarily use or will use foreign FRMs in future (Spearman's correlation r=0.28, p >0.05).

The correlation between the NRs responses, on buying foreign seeds/seedlings from other European Countries Vs sale of reproductive material to foreign clients in future, is found to be insignificant (Spearman's Correlation coefficient r= 0.45, p >0.05) which means the NRs who are willing to buy seed materials from foreign countries might not necessarily / certainly sell their products to other European countries in the future.

CM and FM who thinks climate change to be important do not necessarily use genetic diversity in their management plans (Spearman's correlation r= 0.18, p >0.05). CM and FM who are aware of genetic diversity and also perceives it to be important do not necessarily implement it in their management plan (r = 0.10, p >0.05). This is observed by the negative correlation between, the perception of the importance of genetic diversity and related awareness about it (r = 0.12, p >0.05) in the same group of respondents. Also, the same group of FM and NR respondents who use FRMs from foreign sources do not necessarily feel that the national or European seed transfer legislations are not well adapted to climate change is evident from a negative correlation between them (Spearman's correlation r = -0.79 for FM and r= -0.41 for NR; p <0.00)

Key findings

- *All the three groups of respondents (CM, FM, and NR) perceive that climate change is likely to impact their respective area of operations, in spite of having some country-specific variations in such perception.*
- *The respondents consider afforestation as an important measure for promoting resilience of forests under climate change and generally tend to utilize FRMs locally available.*
- *It was also found that trade and utilization of FRM is mainly guided by the national provenance regions and use of foreign materials is not common*
- *Also, genetic diversity was perceived as an important issue by the respondents across all conservation and forest managers.*

- *However, uncertainty exists among the group of respondents about the effectiveness of national and European legislation on FRMs under climate change*

Acknowledgment

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References

Aitken, S. N., & Whitlock, M. C. (2013). Assisted Gene Flow to Facilitate Local Adaptation to Climate Change. *Annual Review of Ecology, Evolution, and Systematics*, *44*(1), 367–388. doi:10.1146/annurev-ecolsys-110512-135747

Bolte, A., Ammer, C., Löf, M., Madsen, P., Nabuurs, G.-J., Schall, P., … Rock, J. (2009). Adaptive forest management in central Europe: Climate change impacts, strategies and integrative concept. *Scandinavian Journal of Forest Research*, *24*(6), 473–482. doi:10.1080/02827580903418224

Bryman, A. (2012). Social research methods Bryman. *OXFORD University Press*. doi:10.1017/CBO9781107415324.004

Chakraborty, D., Wang, T., Andre, K., Konnert, M., Lexer, M. J., Matulla, C., & Schueler, S. (2015). Selecting Populations for Non-Analogous Climate Conditions Using Universal Response Functions: The Case of Douglas-Fir in Central Europe. *PLOS ONE*, *10*(8), e0136357. doi:10.1371/journal.pone.0136357

Goodman, L. A. (1961). Snowball Sampling. *Annals of Mathematical Statistics*, *32*(1), 148–170. doi:10.1214/aoms/1177705148

Lindner, M., Maroschek, M., Netherer, S., Kremer, A., Barbati, A., Garcia-Gonzalo, J., … Marchetti, M. (2010). Climate change impacts, adaptive capacity, and vulnerability of European forest ecosystems. *Forest Ecology and Management*, *259*(4), 698–709. doi:10.1016/j.foreco.2009.09.023

*Forestry in Austria; Dieter Hanak-Hammerl, Federal Ministry of Agriculture and Forestry, Vienna Available at :http://www.fao.org/docrep/w3722E/w3722e05.htm

*Private forest ownership in Europe; Franz Schmithüsen and Franziska Hirsch , 2010 http://www.unece.org/fileadmin/DAM/timber/publications/SP-26.pdf

*Forestry in Germany https://www.forstwirtschaft-in-deutschland.de/german-forestry/forest-facts/?L=1

*Forests of Poland, 2015, State Report, available at: http://www.lasy.gov.pl/pl/informacje/publikacje/in-english/forests-in-poland/forests-in-poland-2015

*Statistics Slovakia https://rainforests.mongabay.com/deforestation/archive/Slovakia.htm

*Private forest ownership in Europe F. Hirsch, A. Korotkov and M. Wilnhammer , Unaslyva, 228,

Vol. 58 2007 http://www.fao.org/tempref/docrep/fao/010/a1346e/a1346e06.pdf

State of Europe’s Forest, 2015, Forest Europe

Appendix

Table A1 Questionnaire for Conservation manager (CM)

SUSTREE Survey – Conservation managers

Preliminary info

Name of organization/ company/ entity/ park: _____

Country: _____

* The data will be processed anonymously. Multiple answers are possible.

1) Do you consider genetic diversity of forest trees to be important?
   - (a) Yes
   - (b) No
   - (c) I don't know

2) Do you consider forest genetic diversity in your management plans?
   - (a) Yes
   - (b) No
   - (c) I don't know

3) Do you feel you are well informed about forest genetic diversity?
   - (a) Yes
   - (b) No
   - (c) I don't know

4) Do you expect changes of your conservation area due to climate change?
   - (a) Yes
   - (b) No
   - (c) I don't know

   4.1) If YES, will it have any influence on the conservation objectives?

   - (a) Will be easier to reach
   - (b) Will be more difficult to reach
   - (c) Conservation objectives will change
   - (d) Will not have any influence on the conservation objectives

5) Do you consider climate change in you management planning?
   - (a) Yes
   - (b) No
   - (c) I don't know

6) Do you consider planting and afforestation activities in order to improve forest ecosystem services, in particular to increase forest stability in climate change?
   - (a) Yes
   - (b) No
   - (c) I don't know

If YES, ...

6.1) How do you select the forest reproductive material (FRM)?
   - (a) I use material of our own forests (seeds, seedlings, ...)
   - (b) I use material from the closest nursery
   - (c) Other: _____
   - (d) I have never used FRM

6.2) Do you take national regions of provenance into account when selecting the planting material?
   - (a) Yes
   - (b) No
   - (c) I don't know about regions of provenance
   - (d) I have never used FRM in the area

6.3) Have you ever used planting material in the area from other regions outside your country?
   - (a) Yes
   - (b) No

6.3.1) If YES, why?
   - (a) Unavailability of domestic seeds/seedlings
   - (b) Less expensive reproductive material
   - (c) Better genetic material (i.e. better growth, stem form etc.)
   - (d) Better adaptation to expected climate conditions

6.4) Would you use planting material from other regions outside your country?
   - (a) Yes
   - (b) No

7) Have you ever received subsidies for planting activities?
   - (a) Yes
   - (b) No
   - (c) I have never used FRM

8) Please rank the following aspects regarding the importance for the conservation activities in the area :

	(a) Very Important	(b) Important	(c) Less important	(d) Not important	(e) No answer
[1] Plant tree provenances fit for climate change (also from other countries)					
[2] Keep the tree composition of the area the same					
[3] Use of domestic seeds and plants					
[4] Minimize anthropogenic influence in the area					

9) How big is the conservation area of your organization? _____ ha

10) Please specify the category of the conservation area (IUCN categories):
- (a) Ia— Strict Nature Reserve
- (b) Ib — Wilderness Area
- (c) II — National Park
- (d) III — Natural Monument or Natural Feature
- (e) IV — Habitat management area / Species Management Area
- (f) V — Protected Landscape / Protected Seascape
- (g) VI — Protected Area with sustainable use of natural resources (Managed Resource Protected Area)
- (h) Other:_____

11) Please specify roughly the tree composition of your forest:
- Conifers _____ %
  (a.1) (____ % planted (a.2) ____ % natural regeneration)
- Broadleaves _____ %
  (b.1) (____ % planted (b.2) ____ % natural regeneration)
- Mixed stands _____ %
  (c.1) (____ % planted (c.2) ____ % natural regeneration)

12) Comments/ Remarks/ Further explanations to question Nr ___

Table A2 Questionnaire for Forest managers (FM)

SUSTREE Survey – Forest managers

Preliminary info

Name of organization/ company/ entity: _____

Country: _____

* The data will be processed anonymously. Multiple answers are possible.

1Do you consider genetic diversity of forest trees to be important?

- (a) Yes
- (b) No
- (c) I don't know

2Do you consider forest genetic diversity in your management plans?

- (a) Yes
- (b) No
- (c) I don't know

3Do you feel you are well informed about forest genetic diversity?

- (a) Yes
- (b) No
- (c) I don't know

4)Do you consider climate change in you management planning?

- (a) Yes
- (b) No
- (c) I don't know

5)Do you expect changes in your forest area due to climate change?

- (a) Yes
- (b) No
- (c) I don't know

5.1) If YES, will it have any influence on the management objectives?

- (a) Will be easier to reach

- (b) Will be more difficult to reach
- (c) Management objectives will not change

6)Do you consider planting and afforestation activities in order to improve forest ecosystem services, in particular to increase forest stability in climate change?

- (a) Yes
- (b) No
- (c) I don't know

If YES, ...

6.1) How do you select forest reproductive material (FRM)?

- (a) I use material of our own forests (seeds, seedlings, ...)
- (b) I use material from the closest nursery
- (c) Other: _____
- (d) I have never used FRM in the area

6.2) Do you take national regions of provenance into account when selecting the planting material?

- (a) Yes
- (b) No
- (c) I don't know about regions of provenance
- (d) I have never used FRM in the area

6.3) Have you ever used planting material in this area from other regions outside your country?

- (a) Yes
- (b) No
- (c) I don't know

6.3.1) If YES, why?

- (a) Unavailability of domestic seeds/seedlings
- (b) Less expensive reproductive material
- (c) Better genetic material (i.e. better growth, stem form etc.)
- (d) Better adaptation to expected climate conditions

6.4) Would you use planting material from other regions outside your country?

- (a) Yes
- (b) No
- (c) I don't know

7)Have you ever received subsidies for planting activities?

- (a) Yes
- (b) No
- (c) I have never used FRM

8)Please rank the following aspects regarding the importance for the management activities in the area :

	(a) Very Important	(b) Important	(c) Less important	(d) Not important	(e) No answer
[1] Plant tree provenances fit for climate change (also from other countries)					
[2] Keep the tree composition of the area the same					
[3] Use of domestic seeds and plants					
[4] Minimize anthropogenic influence in the area					

9)Do you think the national legislation on seed transfer is well adapted in times of climate change?

- (a) Yes
- (b) No
- (c) I don't know

10)Do you think the European legislation on seed transfer is well adapted in times of climate change?

- (a) Yes
- (b) No
- (c) I don't know

11)How big is the forest area of your organization? _____ ha

12)Please specify the ownership of the forest:

- (a) Private
- (b) Public
- (c) Other, please specify:_____

13) Please specify roughly the tree composition of your forest:

- Conifers _____ %
  (a.1) (____ % planted (a.2) ____ % natural regeneration)

- Broadleaves _____ %
  (b.1) (____ % planted (b.2) ____ % natural regeneration)

- Mixed stands _____ %
  (c.1) (____ % planted (c.2) ____ % natural regeneration)

14) Comments/ Remarks/ Further explanations to question Nr ___

Table A3 Questionnaire for Nurseries (NR)

SUSTREE Survey - Forest nurseries

Preliminary info

Name of organization/ company: _____

Country: _____

* The data will be processed anonymously. Multiple answers are possible.

1)Do you believe that climate change will have an influence on your business?

- (a) Yes
- (b) No
- (c) I don't know

1.1 If yes, what changes are you expecting?

- (a) Increasing demand for other tree species;
  change from conifers to broadleaves
- (b) Increasing demand for forest reproductive material
- (c) Decreasing demand for forest reproductive material
- (d) Increasing demand for non-native tree species (e.g. Douglas fir, red oak)
- (e) Increasing demand for other provenances with higher resistance to climate extremes or new pests/diseases
- (f) Increasing demand for provenances from outside the country
- (g) Others:_____

2)Have you ever received seeds/seedlings from other European countries?

- Yes, because of ...
  - (a) Unavailability of domestic seeds/seedlings
  - (b) Less expensive reproductive material
  - (c) Better genetic material (i.e. better growth, stem form etc.)
  - (d) Better adaptation to expected climate conditions
- (e) No

3)Are you interested in buying forests seeds/ seedlings from other European countries?

- Yes, because of ...
  - (a) Unavailability of domestic seeds/seedlings
  - (b) Less expensive reproductive material
  - (c) Better genetic material (i.e. better growth, stem form etc.)

- (d) Better adaptation to expected climate conditions

- (e) No

4)Do you think you will increasingly sell reproductive material to foreign clients?

- (a) Yes
- (b) No
- (c) I don't know

5)Do you think the national legislation on seed transfer is well adapted in times of climate change?

- (a) Yes
- (b) No
- (c) I don't know

6)Do you think the European legislation on seed transfer is well adapted in times of climate change?

- (a) Yes
- (b) No
- (c) I don't know

7)How many plants are you selling per year?

- (a) 0 – 100 000
- (b) 100 000 – 500 000
- (c) 500 000 – 2 millions
- (d) 2 – 10 millions
- (e) More than 10 millions
- (f) I don't know/ No answer

8)Please specify the percentage of trees sold annually:

- (a) Conifers _____ %

- (b) Broadleaves _____ %

9)The SUSTREE project aims at developing an online information system on forest reproductive material across Central Europe. This information will help users (forest companies, seed trading companies, nurseries, etc.) to inform themselves about reproductive material outside their country and might potentially facilitate trans-national trade and adaptation to changing climate conditions.
Are you interested in listing your company as a potential trans-national provider of forest seeds/seedlings in this online information service?

- (a) **Yes**

  Contact details for online tool
  Name: _____
  Name of company: _____
  Address:
    Street _____
    ZIP Code, City_____
    Country_____
- (b) **No**

10)Comments/ Remarks/ Further explanations to question Nr ___

Table A4 The Questions analyzed to test 1. Perceptions on climate change, 2) Afforestation for promoting stability of forest ecosystem under climate change and 3) Perceptions on genetic diversity and implications of national and regional policies on trade and utilization of FRMs

Perceptions on climate change			Afforestation for promoting stability of forest ecosystem under climate change			Perceptions on genetic diversity and implications of national and regional policies on trade and utilization of FRMs		
CM	**FM**	**Nurseries**	**CM**	**FM**	**Nurseries**	**CM**	**FM**	**Nurseries**
4. Do you expect changes of your conservation area due to climate change?	5. Do you expect changes in your forest area due to climate change?	1. Do you believe that climate change will have an influence on your business?	6. Do you consider planting and afforestation activities in order to improve forest ecosystem services, in particular to increase forest stability in climate change?	6. Do you consider planting and afforestation activities in order to improve forest ecosystem services, in particular to increase forest stability in climate change?	-	1Do you consider genetic diversity of forest trees to be important?	1Do you consider genetic diversity of forest trees to be important?	
4.1 If yes will it have any influence on the conservation objectives	5.1 If yes will it have any influence on the management objectives	1.1) If yes, what changes are you expecting	6.1) If Yes, how do you select forest reproductive material?	6.1) If Yes, how do you select forest reproductive material?		2. Do you consider forest genetic diversity in your management plans?	2. Do you consider forest genetic diversity in your management plans?	

			6.2) Do you take national regions of provenance into account when selecting the planting material?	6.2) Do you take national regions of provenance into account when selecting the planting material?		3. Do you feel you are well informed about forest genetic diversity?	3. Do you feel you are well informed about forest genetic diversity?	
			6.3) Have you ever used planting material in the area from other regions outside your country?	6.3) Have you ever used planting material in the area from other regions outside your country?	2. Have you ever used planting material in the area from other regions outside your country?		9) Do you think the national legislation on seed transfer is well adapted in times of climate change?	5) Do you think the national legislation on seed transfer is well adapted in times of climate change?
			6.3.1) If Yes, why?	6.3.1) If Yes, why?	If yes why?		10) Do you think the European legislation on seed transfer is well adapted in times of climate change?	6) Do you think the European legislation on seed transfer is well adapted in times of climate change?
			6.4) Would you use planting material from other regions outside your country?	6.4) Would you use planting material from other regions outside your country?	3. Are you interested in buying forest seeds/seedlings from other European			

					countries? ?			

Table A5Responses of CM. All figures in percentage of the total responses for the respective question (n)

Q.no	Question	Answer	Responses					
			Austria	Czech Republic	Germany	Hungary	Poland	Slovakia
1	Do you consider genetic diversity of forest trees to be important?	Yes	100	100	100	100	100	100
	n = 49	No	0	0	0	0	0	0
		Uncertain	0	0	0	0	0	0
2.	Do you consider forest genetic diversity in your management plans?	Yes	83	100	71	100	41	57
	n =49	No	17	0	14	0	29	43
		Uncertain	0	0	14	0	29	0
3	Do you feel you are well informed about forest genetic diversity?	Yes	42	40	43	100	53	14
	n =49	No	42	60	43	0	41	43
		Uncertain	17	0	14	0	6	43
4	Do you expect changes of your conservation area due to climate change?	Yes	100	40	100	100	88	71
	n =49	No	0	40	0	0	12	14

		Uncertain	0	20	0	0	0	14
4.1	If Yes, will it have any influence on the conservation objectives?	Will be easier to reach	0	0	0	0	0	0
	n=49	Will be more difficult to reach	8	40	29	0	29	29
		Conservation objectives will change	67	20	29	0	59	29
		Will not have any influence on the conservation objectives	25	40	29	100	0	14
		Non answer	0	0	14	0	12	29
5.	Do you consider climate change in your management planning	Yes	67	60	71	0	35	43
	n =49	No	33	40	29	100	41	57
		Uncertain	0	0	0	0	24	0
6.	Do you consider planting and afforestation activities in order to improve forest ecosystem services, in particular to increase forest stability in climate change?	Yes	50	100	43	100	65	57
	n=49	No	50	0	57	0	29	43
		Uncertain	0	0	0	0	6	0

6.1	If Yes, how do you select forest reproductive material?	I use material of our own forests (seeds, seedlings...)	33	80	14	100	24	0
		I use material from the closest nursery	0	0	29	0	12	0
		Other	17	20	0	0	0	29
		I have never used FRM in the area	0	0	0	0	24	14
6.2	Do you take national regions of provenance into account when selecting the planting material?	Yes	58	100	43	100	53	29
		No	0	0	0	0	6	0
		Don't know	0	0	0	0	0	14
		Never used FRM	8	0	0	0	35	43
			33	0	57	0	6	14
6.3	Have you ever used planting material in the area from other regions outside your country?	Yes	33	0	29	0	0	14
		No	67	100	71	100	100	86
6.3.1	If Yes, why?	Unavailability of domestic seeds/seedlings						
		Less expensive reproductive material						

		Better genetic material (i.e. better growth, stem form etc.)						
		Better adaption to expected climate conditions						
6.4	Would you use planting material from other regions outside your country?	Yes	25	20	0	0	12	29
		No	75	80	100	100	88	71
7	Have you ever received subsidies for planting activities?	Yes	25	40	29	100	41	0
	n = 49	No	33	40	29	0	29	43
		Never used FRM	25	20	43	0	29	57
8	Please rank the following aspects regarding the importance for the conservation activities in the area:							
	n = 49							
	[1] Plant tree provenances fit for climate change (also from other countries)	very important	8	20	43	0	12	14
		important	33	60	14	0	41	43
		less important	17	0	29	0	12	29
		not important	33	0	14	100	18	0

		no answer	8	20	0	0	18	14
	[2] Keep the tree composition of the area the same	very important	50	20	29	0	53	29
		important	33	40	29	0	47	14
		less important	0	20	29	100	0	43
		not important	17	0	14	0	0	14
		no answer	0	20	0	0	0	0
	[3] Use of domestic seeds and plants	very important	42	40	43	0	71	29
		important	17	60	43	100	29	71
		less important	33	0	14	0	0	0
		not important	8	0	0	0	0	0
		no answer						
	[4] Minimize anthropogenic influence in the area	very important	50	60	29	100	71	14
		important	8	20	14	0	29	71
		less important	33	20	43	0	0	14
		not important	0	0	14	0	0	0
		no answer	8	0	0	0	0	0

9	How big is the conservation area of your organization in ha	Not answered						
	n = 49							
10.	Please specify the category of the conservation area (IUCN categories):	Strict Nature Reserve	8	0	0	0	0	0
	n = 45	Wilderness Area	0	0	0	100	0	0
		National Park	17	0	14	0	0	0
		National Monument or Natural Feature	33	60	29	0	59	43
		Habitat management area / Species Management Area	0	0	0	0	0	14
		Protected Landscape / Protected Seascape	8	0	0	0	24	0
		Protected Area with sustainable use of natural resources (Managed Resource Protected Area)	0	40	0	0	0	43
		Other:	0	0	0	0	6	0
		NA = no response	17	0	43	0	6	0

Table A6 Responses of FM. All figures in percentage of the total responses for the respective question (n)

Q.no	Question	Answer	Responses					
			Austria	Czech Republic	Germany	Hungary	Poland	Slovakia
1	Do you consider genetic diversity of forest trees to be important?	Yes	100	100	100	100	96	94
	n = 510	No	0	0	0	0	1	2
		Uncertain	0	0	0	0	3	4
2.	Do you consider forest genetic diversity in your management plans?	Yes	81	91	84	79	87	76
	n =510	No	12	9	10	11	11	18
		Uncertain	7	0	6	11	2	6
3	Do you feel you are well informed about forest genetic diversity?	Yes	50	73	44	53	84	34
	n = 510	No	41	14	38	32	7	54
		Uncertain	8	14	18	16	9	12
4	Do you consider climate change in your management planning?	Yes	91	64	92	84	38	88
	n =508	No	8	14	4	16	48	8
		Uncertain	2	23	4	0	14	4
5	Do you expect changes in your forest area due to climate change?	Yes	95	82	93	100	69	84
	n =510	No	4	5	3	0	9	6
		Uncertain	1	14	4	0	22	8
5.1	If Yes, will it have any influence on the management objectives?	a) Will be easier to reach	6	11	12	11	4	9

	n =433	b) Will be more difficult to reach	81	72	72	53	36	74
		c) Management objectives will change	13	17	16	37	61	16
6.	Do you consider planting and afforestation activities in order to improve forest ecosystem services, in particular to increase forest stability in climate change?	Yes	95	95	97	63	83	96
	n=507	No	5	5	3	21	4	0
		Uncertain	0	0	0	16	11	4
6.1	If yes, how do you select FRMs	a) I use material of our own forests (seeds, seedlings...)	58	59	52	42	54	46
	n =507	b) I use material from the closest nursery	27	27	41	16	9	32
		c) Other	7	9	3	0	2	18
		d) I have never used FRM in the area	0	0	0	5	0	0
	If Yes	a) Yes	98	100	97	100	100	98
6.2	Do you take national regions of provenance into account when selecting the planting material?	b)No	2	0	3	0	0	2
	n = 447	c)Uncertain	0	0	0	0	0	0
		d) Never used FRM	0	0	0	0	0	0
		a) Yes	18	14	22	19	2	4
6.3	Have you ever used planting material in this area from other regions outside your country?	b)No	75	86	75	75	97	96
	n =496	c)Uncertain	7	0	3	6	1	0
6.4	Would you use planting material from other regions outside your country?	Yes	24	23	43	26	13	24

	n = 503	No	64	64	41	53	55	73
		Uncertain	12	14	17	21	32	2
7	Have you ever received subsidies for planting activities?	Yes	27	95	77	89	67	58
	n =489	No	72	5	23	11	33	42
		Uncertain	1	0	0	0	0	0
8	Please rank the following aspects regarding the importance for the management activities in the area:							
	n =507							
8.1	Plant tree provenances fit for climate change (also from other countries)	a)very important	28	5	33	1	21	12
	n =506	b)important	17	3	19	5	46	9
		c)less important	17	3	17	8	49	5
		d)not important	38	0	25	0	13	25
		e)no answer	11	17	6	0	61	6
8.2	Keep the tree composition of the area the same	a)very important	16	2	4	2	72	4
	n = 507	b)important	27	4	28	3	29	9
		c)less important	21	6	42	9	0	22
		d)not important	14	14	52	0	0	19
		e)no answer	20	20	40	0	20	0
8.3	Use of domestic seeds and plants	a)very important	2	1	1	1	4	1
	n =509	b)important	2	0	3	0	4	1
		c)less important	2	0	4	0	3	1
		d)not important	0	0	10	0	0	0
		e)no answer	0	0	5	0	5	0
8.3	Minimize anthropogenic influence in the area	a)very important	3	13	4	7	56	18
	n =506	b)important	17	3	8	4	54	13
		c)less important	28	1	45	1	21	3

		d)not important	41	0	52	3	0	3
		e)no answer	42	0	25	0	25	8
9	Do you think the national legislation on seed transfer is well adapted in times of climate change?	Yes	28	18	34	16	36	48
	n =501	No	26	41	31	26	19	30
		Uncertain	45	41	35	58	45	22
10	Do you think the European legislation on seed transfer is well adapted in times of climate change?	Yes	9	5	14	5	11	10
	n = 498	No	27	9	19	37	8	22
		Uncertain	64	86	66	58	81	68
11	How big is the forest area of your organization (ha)							
12	Please specify the ownership of the forest:	a)public	29	50	62	61	3	2
	n=496	b)private	67	45	21	33	83	20
		c)both	1	0	15	0	4	0
		d) other	3	5	3	6	10	78

Table A7 Responses of NM. All figures in percentage of the total responses for the respective question (n)

Q.no	Question	Answer	Responses					
			Austria	Czech Republic	Germany	Hungary	Poland	Slovakia
1	Do you believe that climate change will have an influence on your business?	Yes	95	70	100	97	69	78
	n =257	No	5	20	0	0	18	13
		Uncertain	0	10	0	3	13	9
1.1	If yes, what changes are you expecting n =140	1)increasing demand for other tree species; change from conifers to broadleaves	63	70	75	35	25	70
		2) Increasing demand for forest reproductive material	32	10	25	19	14	9
		3) Decreasing demand for forest reproductive material	16	10	25	13	3	0
		4) Increasing demand for forest non-native tree species (e.g. Douglas fir, oak)	63	20	75	29	6	26
		5) Increasing demand for other provenances with higher resistance to climate extremes or new pests/diseases	47	10	38	87	46	26
		6) Increasing demand for provenances from outside the country	21	0	25	10	1	39
		7) Others	5	10	13	0	3	9
2.	Have you ever received seeds/seedlings from other European countries?	Yes	84	10	88	29	8	13

	n =257	No	16	90	13	71	91	87
2.1	If yes, because of…	1) Unavailability of domestic seeds/seedlings	53	10	63	26	4	9
		2) Less expensive reproductive material	16	0	13	3	1	0
		3) Better genetic material (i.e. better growth, stem form etc.)	37	0	38	0	2	0
		4) Better adaption to expected climate conditions	32	0	25	0	0	0
3	Are you interested in buying forest seeds/seedlings from other European countries?	Yes	79	0	63	32	10	23
	n=256	No	21	100	38	68	90	77
3.1	If yes, because of…	1) Unavailability of domestic seeds/seedlings	33		36	42	47	57
		2) Less expensive reproductive material	4		0	11	0	14
		3) Better genetic material (i.e. better growth, stem form etc.)	33		45	16	13	14
		4) Better adaption to expected climate conditions	30		18	32	40	14
4	Do you think you will increasingly sell reproductive material to foreign clients?	Yes	26	0	13	13	26	0
	n = 256	No	42	80	88	43	26	57
		Uncertain	32	20	0	43	48	43
5	Do you think the national legislation on seed transfer is well adapted in times of climate change?	Yes	39	70	75	20	31	35

	n = 253	No	22	10	25	40	27	35
		Uncertain	39	20	0	40	41	30
6	Do you think the European legislation on seed transfer is well adapted in times of climate change?	Yes	37	30	38	16	10	22
	n = 257	No	21	10	0	39	18	13
		Uncertain	42	60	63	45	72	57
7.	How many plants are you selling per year?	1) 0 - 100 000	(every response is represented by "1" and no response is "0")					
		2) 100 000 - 500 000						
		3) 500 000 - 2 millions						
		4)2 - 10 millions						
		5) More than 10 millions						
		6)I don't know / No answer						
8	Please specify the % of trees sold annually	a)Conifers						
		b) Broadleaved						
9.	The SUSTREE project aims at developing an online information system on forest reproductive material across Central Europe. This information will help users (forest companies, seed trading companies, nurseries, etc.) to inform themselves about reproductive material outside their country and might potentially facilitate trans-national trade and adaptation to changing climate conditions. Are you interested in listing your company as potential trans-national provider of forest seeds / seedlings in this online information service?	Yes	53	0	25	72	44	72
	n = 186	No	47	100	75	28	56	28