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Prioritization of options for sweetpotato research for development – Results from a global expert survey

Ulrich Kleinwechter, Guy Hareau and Victor Suarez

International Potato Center (CIP), Lima, Peru

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Contact:

RTB Program Management Unit
International Potato Center (CIP)
Apartado 1558, Lima 12, Peru
rtb@cgiar.org • www.rtb.cgiar.org

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Prioritization of options for sweetpotato research for development – Results from a global expert survey

1. Introduction

Sweetpotato (Ipomea batatas (L.) Lam.) is a crop characterized by its wide, robust adaptability to a variety of environmental and adverse growing conditions, such as salinity, drought, or marginal soils, and offers stable productivity that is relatively unaffected by climatic factors (Haimeirong and Kubota 2003; Grüneberg et al. 2009; Woolfe 1992). The crop is very simple to grow (Walker et al. 2011) and its short and flexible vegetation cycle makes it well suited for rotation with other major crops, such as rice, maize, or soybeans (FAO 2008). Thus, it helps to increase the availability of food and raise the aggregate efficiency of agricultural production systems. Importantly, sweetpotato is grown in regions with high incidences of poverty, undernutrition, and food insecurity (Bruinsma 2003), and has the potential to help alleviate poverty and strengthen food security by providing income generation opportunities as a cash crop and by generating employment (Scott, Rosegrant, and Ringler 2000). Further, it is an important source of energy, with a high delivery of edible energy within short periods of time (Woolfe 1992). Finally, sweetpotato is a valuable source of minerals and vitamins, such as anthocyanins, carotenes, and vitamin C (Mukhopadhyay et al. 2011).

To that end, in the 1980s several CGIAR international agricultural research centers—namely the Asian Vegetable Research and Development Centre (AVRDC), the International Institute of Tropical Agriculture (IITA) and, in particular, the International Potato Center (CIP)—started to invest in sweetpotato research, adding to the efforts of a number of national genetic resource conservation and breeding programs in Asia (Mukhopadhyay et al. 2011). Also, major international donors to agricultural research for development have the crop on their priority list, underlining its relevance and potential. Yet technological improvements in sweetpotato have been an underexploited resource (Alexandratos 1997).

In this context—particularly with respect to international agricultural research oriented toward the provision of global public goods—it is important to identify relevant problem areas and define priorities for sweetpotato research. With the beginning of CIP's work on sweetpotato, Horton (1989) in 1987 surveyed sweetpotato experts on constraints to sweetpotato production and use; however, published results of this work are limited to Asia only. Results of a second, more comprehensive and global survey on sweetpotato priorities carried out by CIP in 1990 are still unpublished. The first truly encompassing assessment of priorities for sweetpotato research in developing countries is provided by Fuglie (2007). On the basis of a survey conducted among sweetpotato scientists across 29 developing countries in 2005, the author gives account of priority needs for sweetpotato research globally and for sub-Saharan Africa (SSA) and Asia. And although the survey greatly expands the geographic coverage of the analysis, it relies on a very small sample of only 36 responses and has only a relatively weak representation (2 responses) from the Latin America and Caribbean (LAC) region, the crop's center of origin. More recently, Mukhopadhyay et al. (2011) provide a list of key needs of sweetpotato farmers in developing countries and outline 15 priority areas for sweetpotato research and technology development. Yet the

recommendations appear to be based on the authors' understanding and assessment of the subject area rather than a broader empirical foundation.

In this paper, we present an analysis that not only draws upon the efforts outlined above, but also goes beyond and extends them. As part of a broader undertaking covering multiple crops that took place in the scope of the CGIAR Research Program on Roots, Tubers and Bananas (RTB), we follow an approach previously taken by Horton (1989) and Fuglie (2007), applying a scoring model for the assessment of priorities for sweetpotato research (Ruttan 1982). Sweetpotato experts in areas ranging from production to sector development across the developing world were asked in a survey to score a broad range of research options. They were asked to score the research options according to the perceived importance for helping to reduce poverty and improve food security through sweetpotato research and capacity development, their perceptions of constraints to sweetpotato production and use, and their opinions about the relative importance of alternative research options.

The results give a broad overview of the perceptions of problems affecting the sweetpotato sector and potential solutions. The surveys lead to empirically founded and ranked lists of constraints and associated research options. In the first instance, the results provide a valuable resource for research and program planning in international agricultural research for development. CGIAR research centers and other international institutes dealing with the sweetpotato crop are the primary audiences here. Beyond that, the study also offers a comprehensive insight into the perceptions of the global community of sweetpotato scientists and experts regarding different constraints. The unprecedented scope of the study in terms of geographic coverage and representation of the expert community makes the results a unique source of information.

Respondents had a mean age of 46 years at the time of the survey, with the youngest respondent being 23 years and the oldest 70 years. On average, the survey respondents reported 12 years of experience in sweetpotato research, ranging 0–56 years.

Section 2 below sets out the methodological approach taken for the survey and its analysis, and describes the dataset obtained and used for the analysis. Section 3 presents the results from the survey, providing evidence of priorities for sweetpotato research in developing countries. Section 4 summarizes the paper and draws conclusions.

2. Materials and Methods

For the expert survey, a structured questionnaire is applied. The questionnaire is based on a format previously applied at CIP (Fuglie 2007) and consists of two sections. In a first section, the questionnaire asks for information about the respondents. This information encompasses personal information: gender and age, experience in work on sweetpotato, type of organization a respondent works for, the country or region and the crop agro-ecology his or her work is focused on, and the respondent's professional and disciplinary background.

The main section of the questionnaire deals with the different constraints and research options. Respondents are provided with a list of 86 research options, organized around the areas of crop improvement, crop and resource management, seed management, genetic resources, value chains, postharvest utilization, and marketing as well as socioeconomic research and extension. The list of research options draws on the questionnaire used by Fuglie (2007), which has been revised taking into

account the input by CIP sweetpotato experts and, where necessary, changed and amended. This approach ensures, on the one hand, a certain degree of comparability with the previous study, and, on the other hand, the relevance of the list of research options and its endorsement by crop scientists.

For each of the research options, respondents are asked to assign a score from 1 (not important) to 5 (very important), according to their perception of the importance of the respective option for helping to reduce poverty and improve food security through crop research and capacity development. In addition, for each area, respondents are offered the possibility to specify and score other options that may not have been included in the initial list.

The selection of the group of experts to take part in the survey was guided by several objectives. First, to obtain responses of sufficiently high quality, the respondents would need a sound knowledge of the sweetpotato crop. They should be able to identify and assess problems and constraints associated with production and sector development. Further, the target group should be selected so as to consider the views of experts from a variety of backgrounds with a stake in sweetpotato research. Thus, the selection has to be wide enough to cover not only the science community, but also include representatives from the private sector and the development community.

Accordingly, a combination of approaches has been taken to reach out to the expert community. First, questionnaires were distributed to participants of professional meetings with regional scope. These gatherings were (1) a meeting of sweetpotato breeders held in Belgium, 7–9 September 2012; (2) the 3rd Annual Technical Meeting of the Sweetpotato for Profit and Health Initiative (SPHI) in Kenya (11–13 September 2012); and (3) the 16th International Symposium of the International Society for Tuber & Root Crops (ISTRC) in Nigeria (23–28 September 2012). Second, the survey has been rolled out online at a global scale. For the online survey, a list with experts and stakeholders has been compiled based on information requested from regional CIP researchers, crop experts in individual countries, professional networks (e.g., Philrootcrops in the Philippines), and the Inter-American Institute for Cooperation in Agriculture (for LAC). Also, a review of scientific publications has been carried out to identify authors of relevant publications. To make the survey more accessible to a global audience, the questionnaires have been translated and made available in English, Spanish, and Chinese. A total of 351 individuals have been invited by personal email to participate in the online survey. Invitations were sent in two waves: in January 2013 to experts in China and in June 2013 to experts in Latin America, Africa, and the rest of Asia. One reminder was sent two weeks after each initial invitation. Further, the contacted experts were invited to forward the invitation to interested colleagues and the survey was accessible via RTB's website. A full timeline of the survey activities is available in Annex 1.

Results are analyzed by calculations of mean scores for each of the research options evaluated in the survey, where higher values indicate the perception of higher importance among the respondents. To provide a rough indication of the significance of observed differences, the standard errors of the mean are calculated. The results are presented at the global level, using the entire sample. In addition, breakdowns by regions and gender are provided.

Overall, 216 questionnaires have been completed and returned to CIP. Of survey respondents 26% are female. Regarding the regional orientation, respondents have been asked to characterize their work as being global, regional (belonging to one out of nine regions), or national. For the purpose of this report, respondents who indicated national were assigned to the respective region; multiple responses were possible. In the analyses, the cases that marked more than one region are included in the sub-sample for each of the regions indicated, which leads to some double counting. Slightly more than one

third of respondents (36%) characterized their work as taking place in SSA, with Western and Central Africa accounting for 11%, Eastern Africa for 17%, and Southern Africa for 8% (Table 1). LAC were stated by 11% of the responses. Thirty-six percent of the responses referred to Asia, with Eastern Asia and the Pacific (mainly China) having the strongest representation (27%), followed by Southern Asia (7%) and South West and Central Asia (SWCA) (2%). A global scope of work was indicated by 13% and single cases mentioned the remaining regions. Sixty-seven individuals reported more than one region.

To assign the answers received to specific crop agro-ecologies, respondents were provided with a list of agro-climatic regions corresponding to zones from the Köppen-Geiger climate classification (Peel, Finlayson, and McMahon 2007). The Köppen-Geiger classification was chosen because it is widely understood and because it is considered meaningful for defining sweetpotato crop agro-ecologies. The survey covers all tropical and subtropical agro-ecologies considered relevant for sweetpotato (Table 2). Most respondents indicated subtropical humid environments (20%) and semi-arid environments (20%), followed by tropical or subtropical highlands (18%) and tropical humid savannah environments (14%). Tropical humid forest environments were chosen by 12%, tropical monsoon environments by 9%, and another 8% indicated others. It is worth highlighting that 137 respondents mentioned more than one agro-ecological zone (around 1.6 zones per respondent on average).

TABLE 1: NUMBER OF RESPONDENTS BY REGION.

		Total responses (N=216)	***Share in total***
Global		36	0.13
LAC		31	0.11
SSA			
	Western and Central Africa	32	0.11
	Eastern Africa	47	0.17
	Southern Africa	23	0.08
Asia			
	SWCA	6	0.02
	Southern Asia	20	0.07
	Eastern Asia and Pacific	77	0.27
Europe		4	0.01
North America		4	0.01
Other		3	0.01
Total		283	1

As Table 3 shows, a large share of the sample is made up of scientists, from national agricultural research institutes (NARS) (43%), universities (14%), or CGIAR (mostly CIP, 13%). Research managers from NARS and university students account for another 15% and 5%, respectively. Persons from outside

the field of research, such as extensionists, nongovernmental organizations (NGOs), donors, policy makers, make up the rest of the sample, accounting together for 10%.

TABLE 2: NUMBER OF RESPONDENTS BY CROP AGRO-ECOLOGY.

	Total responses (N=216)	***Share in total***
Tropical monsoon (*Am*)	30	0.09
Tropical humid savannah environments (*Aw*)	49	0.14
Subtropical humid environments (*Cfa, Cwa*)	69	0.20
Tropical humid forest environments (*Af*)	43	0.12
Tropical or subtropical highlands (*Cwb)*	62	0.18
Semi-arid environments (*Bwh, Bsh)*	72	0.20
Other	28	0.08
Total	353	1

TABLE 3: NUMBER OF RESPONDENTS BY PROFESSION.

	Total responses (N=205)	***Share in total***
Research manager from NARS	31	0.15
Research scientist from NARS	88	0.43
Research scientist or lecturer at a university	29	0.14
Student conducting research at a university	11	0.05
Extension agent	6	0.03
Representative of an NGO	8	0.04
Representative of a donor to the CGIAR system	2	0.01
CGIAR center scientist	26	0.13
Employee of a private, for-profit company	1	0.00
Other	3	0.01
Total	205	1

The survey covered experts with a broad range of disciplinary backgrounds (Table 4). Respondents assigned themselves to, on average, 3.6 different disciplines. The highest coverage (roughly 75%) comes from the wider field of natural sciences, including plant breeding, genetics, crop and resource management, climate change, and nutrition. Disciplines that are related to social sciences in the broadest sense and management/administration are also well represented but make up a smaller share of the sample.

The following section presents the results obtained from the surveys, providing interesting insights into the perceptions of the sweetpotato community about the relative importance of constraints and research options.

TABLE 4: NUMBER OF RESPONDENTS BY DISCIPLINE.

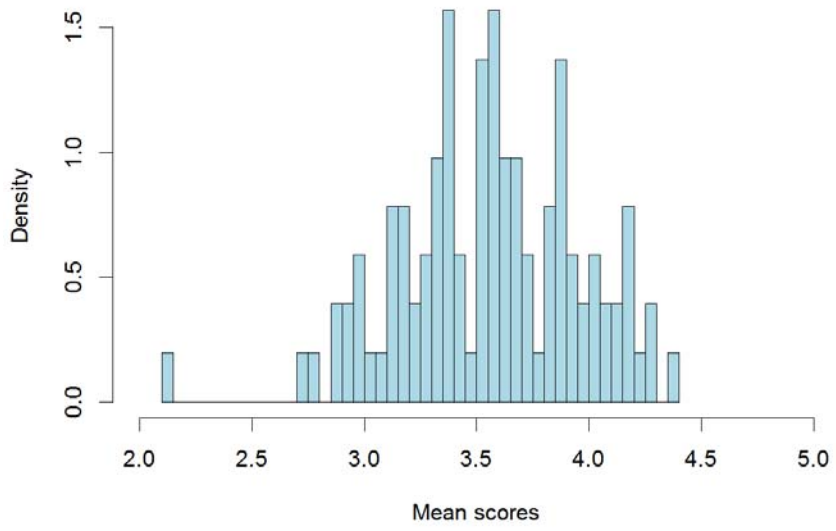
	Total responses (N=216)	***Share in total***
Crop genetic resources	56	0.07
Participatory plant breeding	52	0.07
Transgenic research	20	0.03
Tissue culture	36	0.05
Soils/nutrient management	30	0.04
Cropping/farming systems	55	0.07
Economics or policy	12	0.02
Nutrition	21	0.03
Monitoring and evaluation	21	0.03
Harvest management, storage, transport	15	0.02
Cultural anthropology or rural sociology	4	0.01
Research planning and administration	39	0.05
Genomics, bioinformatics, molecular biology	29	0.04
Plant breeding and conventional genetics	82	0.11
Crop management, agronomy, physiology	71	0.09
Water management in crop production	15	0.02
Crop diseases and their management	35	0.05
Crop pests and their management	28	0.04
Climate change specialist	7	0.01
Seed systems and virus management	33	0.04
Dissemination/technology transfer	31	0.04
Value chain development and management	17	0.02
Training and knowledge management	28	0.04
Development planning and administration	15	0.02
Other (string)	21	0.03
Total	773	1

3. Results

The results are presented following the way information was gathered in the questionnaire. Results are grouped into four broad categories of research options: crop genetic improvement; production technology, agronomy, and crop management; improvement of seed and planting materials; other options for sweetpotato research. For each category, the number of responses for each score over all responses (all regions) and the total number of responses are given. Further, for all options the mean score and the standard error of the mean are provided. Since those standard errors are around 0.10 on average, a 95% confidence interval lies roughly about 0.19 score points around the mean. [1] To offer a breakdown by regions, the mean scores for responses from LAC, SSA, East and South East Asia (ESEA), and SWCA are reported. Finally, to make differences between male and female respondents explicit, the mean scores for both sexes are included in the table.

To facilitate the interpretation of the results, Figure 1 depicts the distribution of the mean scores in the sample. The mean of the global score across all research options is 3.55; the median is at 3.57. The highest mean score given to any of the research options is 4.35, the minimum is 2.12, and the first and third quartiles are marked by 3.31 and 3.86, respectively. Thus, most research options have received a score of 3.00 or higher and are therefore considered to be "important" to "very important." For a verbal classification of the relative ranking of the research options, in the following discussions mean scores in the fourth quartile (>3.86) will be described as "high" and scores below the median (3.57) as "low.".

FIGURE 1: HISTOGRAM OF MEAN SCORES, GLOBAL SAMPLE.



[1] This calculation includes the questions on "others" at the end of each section of the questionnaires. These questions typically have higher standard errors. Thus, the confidence intervals will actually be smaller for most of the questions, in particular where specific research options were given.

The prioritization of research options for crop genetic improvement made by the respondents is presented in Table 5. The first section of the table deals with options related to crop yield and quality. Respondents consider high yields and high contents of dry matter to be of highest importance for sweetpotato breeding. A third highly ranked area is processing quality. Other options related to yield and quality rank significantly lower. In this first category, it is interesting to see that both traits related to productive performance (high yields, nutrient-use efficiency) and quality traits (dry matter, processing quality) are highly ranked. This implies that respondents explicitly or implicitly recognize that sweetpotato breeding has to take into account both parameters related to supply (higher and better production) and demand (marketability, use).

In the section on breeding for nutritional quality, breeding for high pro-vitamin A content receives a score of 4.26. This is the second highest score of all research options dealt with in the survey and stands out in the section on breeding for nutritional quality. This result may be related to the high prominence of orange-fleshed sweetpotato (OFSP) in the sweetpotato-related work in Africa (compare score of 4.70 in SSA) and to the fact that a substantial part of the respondents to the survey from that region are linked to the respective projects (SPHI and the Sweetpotato Action for Security and Health in Africa initiative, or SASHA). Breeding for better retention of micronutrients during processing and storage (3.63) and for higher levels of anthocyanins (3.58) receive scores similar to each other, but are already significantly lower than pro-vitamin A. Similarly, breeding for higher contents of iron and zinc have scores that are not significantly different from each other (3.42 and 3.38, respectively).

Among the options for breeding for biotic stress resistance, resistance against the sweetpotato virus disease (SPVD) and sweetpotato weevils are both highly ranked (mean scores of 4.17 and 4.12, respectively). These results are consistent with statements from the literature where both SPVD and sweetpotato weevils are considered the principal biotic constraints affecting sweetpotato (Chalfant et al. 1990; Talekar 1982; Smit 1997; Sutherland 1986; Drok 2011). Consequently, breeding for other biotic constraints like fungal diseases and root rots, whiteflies and aphids, nematodes, anthracnose, or moles and rats consistently receives lower scores.

Although sweetpotato per se already is more drought tolerant than other crops (Ravi, Ravindran, and Ramesh 2008), improving the adaptation to drought is the highest ranked option related to breeding for resistance to or tolerance of abiotic constraints. Its mean score of 4.15 is significantly higher than the one of tolerance to marginal soils, the next highly ranked alternative (mean score of 3.59). Tolerance of soil salinity (3.44) and heat (3.31) still receive scores in the middle range, whereas tolerance to water logging (3.19) and cold/highland hardiness (2.99) receive low scores.

In the field of breeding for environmental adaptation, breeding for early harvest is ranked highly, with a mean score of 4.06. Breeding for medium maturity (3.02) and shade tolerance (2.93) receive low scores.

Among other opportunities for crop improvement, germplasm enhancement and pre-breeding is ranked highly with a mean score of 3.94. Improved accelerated breeding methods receives a score of 3.84, followed by the exploitation of heterosis (3.67). With a score of 3.54, the use of molecular markers is ranked low.

TABLE 5: PRIORITIZATION OF OPTIONS FOR CROP GENETIC IMPROVEMENT.

	All responses						All regions		LAC	SSA	ESEA	SWCA	CGIAR	Male	Female
	Number of responses ranking importance (1 to 5)														
	1	2	3	4	5	Total responses	Mean score	s.e. (mean)	Mean score	Mean score	Mean score	Mean score	Mean score	Mean score	Mean score
Yield and quality															
High yield	2	1	37	68	100	209	**4.26**	0.06	**4.21**	**4.61**	**4.10**	4.00	**4.42**	**4.21**	**4.41**
High dry matter	3	11	38	81	71	206	4.01	0.07	3.63	4.30	3.92	4.25	4.16	3.98	4.17
Processing quality	2	12	49	85	55	205	3.88	0.06	3.75	3.96	3.87	4.00	3.87	3.84	3.98
Nutrient-use efficiency	6	24	46	61	42	193	3.61	0.08	3.69	3.73	3.49	3.75	3.95	3.49	4.02
Dual purpose use	1	23	77	65	31	200	3.52	0.07	3.57	3.71	3.38	**4.50**	3.87	3.48	3.63
Root form/ shape	12	37	77	48	18	197	3.12	0.07	3.46	3.18	3.04	2.33	2.90	3.10	3.17
Vegetable types	15	49	72	48	10	201	2.94	0.07	3.21	2.71	3.15	2.67	2.76	2.86	3.16
Forage use	20	54	81	32	10	201	2.79	0.07	3.07	2.88	2.67	3.33	3.09	2.79	2.82
Low sugar content (non-sweet)	21	67	59	36	10	199	2.73	0.08	2.52	2.59	2.85	3.00	2.82	2.65	2.94
Other	1	3	6	12	13	45	3.94	0.18	3.43	4.60	4.00	2.00	3.33	3.90	4.00
Nutritional quality															
Pro-vitamin A	1	3	35	67	103	211	**4.28**	0.06	**4.21**	**4.70**	**4.00**	**4.50**	**4.52**	**4.20**	**4.51**
Retention of micronutrients during processing and storage	5	20	62	64	44	201	3.63	0.07	3.58	3.83	3.55	3.33	3.91	3.45	4.06
Anthocyanins (purple-fleshed)/ antioxidants	8	21	55	71	39	201	3.58	0.08	3.56	3.25	3.82	4.00	3.00	3.53	3.72
Iron	4	36	66	56	35	201	3.42	0.07	3.62	3.58	3.26	3.75	3.50	3.27	3.83
Zinc	3	39	65	56	31	201	3.38	0.07	3.48	3.52	3.23	4.00	3.55	3.22	3.85
Other	1	1	6	8	4	29	3.65	0.23	3.50	4.67	3.67	2.00	3.00	3.63	4.00
Biotic stress resistance															
Sweetpotato weevils	2	8	40	59	97	209	**4.17**	0.07	**4.11**	4.46	**4.00**	**4.50**	**4.35**	**4.12**	4.29
SPVD	4	13	28	65	90	205	4.12	0.07	3.89	**4.65**	3.90	3.00	**4.35**	4.05	**4.34**
Fungal diseases and root rots	8	13	63	83	31	203	3.59	0.07	3.54	3.70	3.59	2.75	2.95	3.58	3.59
Nematodes	11	21	67	68	25	197	3.39	0.07	3.39	3.34	3.51	2.33	2.91	3.33	3.57
Whiteflies and aphids	8	34	73	47	29	198	3.29	0.08	3.29	3.45	3.28	3.00	3.25	3.23	3.53
Anthracnose	15	34	79	45	9	195	2.99	0.07	3.15	3.10	2.96	2.75	2.62	2.96	3.09
Moles and rats	18	60	58	29	22	196	2.88	0.08	3.00	2.94	2.82	2.67	2.57	2.76	3.23
Other biotic stresses	3	5	18	15	12	67	3.53	0.15	4.00	3.67	3.32	3.00	3.67	3.45	3.70
Abiotic stress resistance/tolerance															
Drought	2	5	33	87	79	208	**4.15**	0.06	**4.29**	**4.34**	**4.04**	4.25	**4.32**	**4.09**	**4.31**

	All responses: Number of responses ranking importance (1 to 5)						All regions		LAC	SSA	ESEA	SWCA	CGIAR	Male	Female
	1	2	3	4	5	Total responses	Mean score	s.e. (mean)	Mean score	Mean score	Mean score	Mean score	Mean score	Mean score	Mean score
Marginal soils	4	22	56	77	33	197	3.59	0.07	3.93	3.43	3.70	3.33	3.41	3.53	3.77
Soil salinity tolerance	5	18	55	50	22	159	3.44	0.08	3.16	3.26	3.56	**4.33**	3.13	3.32	3.79
Heat	7	39	61	61	26	198	3.31	0.08	3.71	3.57	3.09	3.33	3.48	3.21	3.57
Water logging	10	33	77	55	17	197	3.19	0.07	2.92	3.17	3.36	3.33	2.80	3.09	3.50
Cold tolerance/ highland hardiness	22	40	66	43	20	195	2.99	0.08	2.52	3.20	3.12	3.25	3.36	2.96	3.14
Other abiotic stresses	2	4	9	9	4	42	3.32	0.21	3.14	3.75	3.44	1.00	2.00	3.32	3.33
Environmental adaptation															
Early harvest	1	8	42	79	73	207	**4.06**	0.06	**4.07**	**4.16**	**3.98**	**4.50**	**4.35**	**4.01**	**4.15**
Medium maturity	17	40	64	46	16	192	3.02	0.08	3.24	3.21	2.86	4.00	3.05	3.03	3.02
Shade tolerance	18	46	62	39	15	193	2.93	0.08	2.84	2.60	3.21	3.00	2.50	2.86	3.10
Other	4	5	4	8	1	35	2.86	0.27	3.17	3.14	2.67	1.00	1.00	3.00	2.25
Other opportunities for crop improvement															
Germplasm enhancement and pre-breeding	1	8	51	72	59	201	**3.94**	0.06	**3.85**	4.03	**3.94**	**4.25**	4.05	**3.89**	**4.04**
Improved accelerated breeding methods	2	10	50	73	47	194	3.84	0.07	3.64	**4.28**	3.60	**4.25**	**4.40**	3.78	4.02
Exploitation of heterosis	2	13	58	72	32	194	3.67	0.07	3.40	3.95	3.51	**4.25**	4.05	3.68	3.63
Exploitation of molecular markers	4	15	68	73	25	197	3.54	0.07	3.54	3.68	3.40	3.75	3.53	3.49	3.64
Others	1	2	7	4	2	34	3.25	0.27	2.75	3.60	3.33	1.00	3.00	3.14	4.00

[a] 1 = not important, 2 = low importance, 3 = important, 4 = very important, 5 = most important.

Source: Authors' survey.

Options for production technology, agronomy, and crop management comprise constraints and technologies related to the management of soils, water, weeds, and harvest and the control and management of diseases and pests (Table 6). Options from the field of management of soils, water, weeds, and harvest receive scores in the low to middle range. None of the options is highly ranked. The mean scores achieved range from 3.84 in case of the improvement of sweetpotato cropping systems (a rather generally formulated option) to 3.11 in case of managing soil acidity. Among the higher ranked options in that field are, apart from the aforementioned improvement of cropping systems, the improvement of soil fertility (3.74), water management in crop production (3.62), and the improvement of methods or machinery for planting/harvesting (3.58).

TABLE 6: PRIORITIZATION OF OPTIONS FOR PRODUCTION TECHNOLOGY, AGRONOMY, AND CROP MANAGEMENT.

	All responses														
	Number of responses ranking importance (1 to 5)						All regions		LAC	SSA	ESEA	SWCA	CGIAR	Male	Female
	1	2	3	4	5	Total responses	Mean score	s.e. (mean)	Mean score	Mean score	Mean score	Mean score	Mean score	Mean score	Mean score
Soils, water, weeds, and harvest															
Improving sweetpotato cropping systems	3	6	53	98	41	205	**3.84**	0.06	**3.90**	**3.95**	**3.75**	4.25	**3.95**	**3.72**	**4.19**
Improving soil fertility (micronutrients and fertilizer)	2	14	62	79	44	205	3.74	0.06	3.76	3.88	3.67	3.33	3.61	3.67	3.90
Water management in crop production	5	16	68	70	40	204	3.62	0.07	3.71	3.84	3.43	3.33	3.86	3.52	3.94
Improving methods or machinery for planting/harvesting	10	29	45	66	49	203	3.58	0.08	3.39	3.39	3.84	**4.50**	3.05	3.56	3.65
Weed management and control	2	22	77	70	25	200	3.48	0.06	3.38	3.53	3.45	3.67	3.15	3.44	3.59
Soil management and erosion control	5	23	84	62	21	201	3.36	0.07	3.66	3.47	3.28	3.33	3.33	3.31	3.54
Gender-friendly labor saving tools	11	27	62	72	24	200	3.36	0.07	3.48	3.31	3.37	4.00	3.29	3.33	3.46
Managing soil salinity	5	47	71	47	18	197	3.14	0.07	3.00	3.11	3.23	3.50	2.75	3.03	3.45
Managing soil acidity	5	45	77	43	16	198	3.11	0.07	3.31	3.11	3.08	3.00	2.85	3.01	3.46
Others	1	4	3	4	2	25	3.14	0.33	3.00	4.00	3.67	1.00	1.00	3.00	5.00
Disease control and management															
SPVD	2	12	26	68	93	204	**4.18**	0.07	**3.93**	**4.63**	**4.02**	3.50	**4.46**	**4.14**	**4.36**
Sweetpotato storage diseases	4	12	56	89	37	203	3.72	0.06	3.70	3.78	3.70	**4.25**	3.41	3.66	3.90
Alternaria spp.	5	36	69	57	15	194	3.23	0.07	3.19	3.33	3.30	1.67	3.05	3.12	3.52
Bacterial diseases	7	40	58	54	13	190	3.15	0.08	3.15	3.08	3.29	2.00	2.61	3.06	3.42
Others	1	4	5	7	2	33	3.26	0.25	3.17	3.25	3.60	2.00	1.50	3.25	3.33
Pest control and management															
Sweetpotato weevils	2	9	39	51	99	205	**4.18**	0.07	**3.90**	**4.50**	**4.04**	**4.50**	**4.50**	**4.09**	**4.44**
White flies and aphids	2	30	61	55	40	196	3.54	0.08	3.46	3.68	3.50	3.50	3.38	3.47	3.83
Nematodes	6	25	67	71	18	200	3.37	0.07	3.14	3.25	3.55	3.25	2.86	3.35	3.48
Weeds	6	21	87	61	17	197	3.32	0.06	3.52	3.29	3.29	3.00	2.81	3.28	3.43
Others	1	4	6	6	4	36	3.38	0.25	3.17	3.40	3.67	2.00	1.50	3.14	3.67

[a] 1 = not important, 2 = low importance, 3 = important, 4 = very important, 5 = most important.

Source: Authors' survey.

The mean scores of options related to the control and management of diseases and pests are consistent with the results from the area of breeding: both SPVD and sweetpotato weevils have very high mean scores of 4.18. The mean scores for the other alternatives in both fields are significantly lower. Control and management of sweetpotato storage diseases are scored with 3.72 on average, followed by Alternaria (3.23) and bacterial diseases (3.15). With respect to pest control and management, white flies got a mean score of 3.54. Nematodes (3.37) and weeds (3.32) are among the pest control and management options with the lowest scores.

As Table 7 shows, overall, research on seeds or planting materials appears to be of highest importance for sweetpotatoes. The improvement of the quality of planting material is the option with the highest overall score among all research options (mean score of 4.35). Moreover, the improvement of both formal and informal seed systems received very high mean scores (4.21 and 4.01, respectively) and the improvement of seed storage also ranks high (3.87). The development of mass propagation methods received a moderately high mean score (3.80) and only research on roots as source of planting material scores low (3.33).

TABLE 7: PRIORITIZATION OF OPTIONS FOR IMPROVEMENT OF SEEDS OR PLANTING MATERIALS.

	All responses														
	Number of responses ranking importance (1 to 5)						*All regions*		*LAC*	*SSA*	*ESEA*	*SWCA*	*CGIAR*	*Male*	*Female*
	1	*2*	*3*	*4*	*5*	*Total responses*	*Mean score*	*s.e. (mean)*	*Mean score*	*Mean score*	*Mean score*	*Mean score*	*Mean score*	*Mean score*	*Mean score*
Improving the quality of planting material (elimination of diseases, etc.)	1	3	22	75	103	205	**4.35**	0.05	**4.29**	**4.71**	**4.14**	4.25	4.48	**4.30**	**4.48**
Improving production and distribution of elite planting materials (formal)	2	1	26	97	77	204	4.21	0.05	4.21	4.46	4.06	**4.50**	4.35	4.19	4.27
Improving technologies for farmer-based production and distribution of planting materials (informal)	3	7	44	78	69	203	4.01	0.06	3.82	4.53	3.68	4.00	**4.57**	3.90	4.31
Improving seed storage	4	8	53	82	54	203	3.87	0.07	3.70	4.13	3.76	4.00	4.04	3.87	3.88
Mass propagation methods	2	15	53	76	50	200	3.80	0.07	3.96	3.94	3.69	3.00	3.75	3.75	3.96
Roots as source of "seed" material	9	33	62	63	26	198	3.33	0.08	3.32	3.44	3.42	3.00	3.96	3.20	3.73
Others	1	4	3	5	2	26	3.20	0.31	3.00	4.00	3.00	1.00	1.00	3.21	3.00

[a] 1 = not important, 2 = low importance, 3 = important, 4 = very important, 5 = most important.

Source: Authors' survey.

Other options for sweetpotato research considered in the survey concern various other fields, including genetic resource management, value chains, postharvest utilization and marketing, socioeconomic, policy and impact studies, as well as extension (Table 8). In the area of genetic resource management, phenotypic or molecular screening of landraces and the collection, characterization, evaluation, and documentation of crop genetic resources obtained the highest scores. With mean scores of 3.90 and 3.87, respectively, both of them appear in the highest quartile of all research options. In-situ genetic resource management (3.67) and the management of intellectual property rights and material transfer agreement (3.44) obtained significantly lower scores.

In the area of value chains, postharvest utilization, and marketing, half of the research options presented were considered to be very important and received high mean scores. The highest ranked alternative in that area is the improvement of the shelf life of sweetpotato roots (mean score of 4.16), followed closely by the development of sweetpotato products for human consumption (4.08), the development of sweetpotato products for industrial applications (4.01), and the development of competitive value chains (3.99). Further highly ranked alternatives are the improvement of small-scale processing of sweetpotatoes (3.95), the development of farmer organizations and farmer clusters linked

to markets (3.91), and research on alternative technologies for on-farm utilization and processing for value addition (3.87). That all these highly ranked alternatives are related to improved commercialization and marketing of the crop once more shows that the respondents recognize the importance of aspects related to sweetpotato demand for their work.

TABLE 8: PRIORITIZATION OF OTHER OPTIONS FOR SWEETPOTATO RESEARCH.

	All responses														
	Number of responses ranking importance (1 to 5)						*All regions*		*LAC*	*SSA*	*ESEA*	*SWCA*	*CGIAR*	*Male*	*Female*
	1	*2*	*3*	*4*	*5*	*Total responses*	*Mean score*	*s.e. (mean)*	*Mean score*	*Mean score*	*Mean score*	*Mean score*	*Mean score*	*Mean score*	*Mean score*
Genetic resource management															
Phenotypic/molecular screening of landraces	1	10	49	80	52	200	**3.90**	0.06	**4.04**	**4.02**	3.80	**4.25**	**3.95**	**3.83**	**4.07**
Collection, characterization, evaluation, documentation (ex situ)	2	10	53	77	53	202	3.87	0.07	3.89	3.91	**3.85**	**4.25**	**3.81**	3.81	4.02
In-situ genetic resource management	1	15	65	73	35	197	3.67	0.06	3.69	3.61	3.71	3.67	3.50	3.63	3.80
Management of intellectual property rights and material transfer agreements	5	22	77	60	28	199	3.44	0.07	3.42	3.54	3.43	3.25	2.85	3.35	3.72
Others	3	4	2	2	16	27	3.27	0.33	2.00	4.25	3.50	2.50	2.00	2.50	4.20
Value chains, postharvest utilization, and marketing															
Improving shelf life of sweetpotato roots	3	4	32	82	81	203	**4.16**	0.06	**4.04**	**4.38**	**4.05**	**4.50**	**4.32**	**4.12**	**4.27**
Developing sweetpotato products for human consumption	1	6	34	94	66	202	4.08	0.06	4.00	4.25	3.96	4.25	4.16	4.07	4.10
Developing sweetpotato products for industrial applications	0	14	34	87	63	201	4.01	0.06	4.08	4.08	3.95	4.25	4.00	3.97	4.10
Development of competitive value chains	1	5	51	73	63	198	3.99	0.06	4.08	4.15	3.85	4.25	4.26	3.94	4.18
Improving small-scale processing of sweetpotato for human consumption	3	6	54	69	66	201	3.95	0.07	4.00	4.27	3.75	4.00	4.00	3.90	4.08
Development of farmer organizations and clusters linked to markets	2	9	50	75	56	199	3.91	0.07	4.00	4.09	3.74	3.67	4.00	3.87	4.00
Alternative on-farm utilization/processing for value addition	1	7	58	79	50	198	3.87	0.06	3.96	4.09	3.68	3.75	3.83	3.85	3.91
Improving in ground roots on-farm storage	2	12	67	68	39	194	3.69	0.07	3.48	4.02	3.62	3.67	3.82	3.58	4.07
Developing sweetpotato products for animal feed	4	23	57	79	28	194	3.54	0.07	3.72	3.75	3.29	3.67	4.04	3.49	3.65
Improving above-ground roots on-farm storage	5	32	49	65	37	197	3.52	0.08	3.68	4.05	3.04	4.00	4.05	3.40	3.88

	All responses						All regions		LAC	SSA	ESEA	SWCA	CGIAR	Male	Female
	Number of responses ranking importance (1 to 5)														
	1	2	3	4	5	Total responses	Mean score	s.e. (mean)	Mean score	Mean score	Mean score	Mean score	Mean score	Mean score	Mean score
Research on more gender equitable value chains	5	37	57	56	28	194	3.36	0.08	3.50	3.70	3.04	4.00	3.73	3.20	3.82
Improve management of residues	6	27	71	63	21	195	3.35	0.07	3.27	3.20	3.57	3.00	2.86	3.36	3.33
Ethanol production from sweetpotato	19	49	48	53	22	196	3.05	0.09	2.85	2.78	3.39	3.00	2.30	3.03	3.11
Others	0	3	2	4	3	28	3.58	0.34	3.00	4.00	3.00	3.00	NaN	3.50	4.00
Socioeconomic, policy, and impact studies															
Assessment of sweetpotato research and development	0	12	54	86	42	195	**3.81**	0.06	3.64	**4.13**	**3.65**	3.75	3.78	**3.80**	3.85
Assessment of sweetpotato technology adoption	1	10	68	75	43	199	3.76	0.06	3.62	4.03	3.59	**4.00**	3.78	3.72	3.85
Assessment of small farmer access to new technologies	1	11	70	76	40	200	3.72	0.06	3.65	3.97	3.51	**4.00**	**3.82**	3.66	3.94
Assessment of sweetpotato-based innovation systems	1	13	66	80	35	197	3.69	0.06	**3.77**	3.85	3.58	**4.00**	3.71	3.68	3.70
Research on food and agricultural policies affecting sweetpotatoes	4	18	57	71	39	193	3.65	0.07	3.50	3.88	3.59	3.00	3.62	3.67	3.67
Improving policy framework for sweetpotato planting materials	4	18	63	66	42	195	3.64	0.07	3.50	4.02	3.46	3.75	**3.82**	3.59	3.78
Assessment of health effects of bio-fortified sweetpotato varieties	4	30	47	76	39	198	3.59	0.07	3.69	3.73	3.54	2.75	3.63	3.46	**3.98**
Assessment of health and environmental risks of herbicide and pesticide use in sweetpotato systems	10	33	59	60	30	195	3.35	0.08	3.69	3.20	3.45	3.00	2.70	3.31	3.51
Study gender inequality in sweetpotato production systems	10	50	70	45	12	194	2.99	0.07	3.04	3.25	2.83	3.00	3.17	2.91	3.22
Others	0	1	6	4	2	26	3.54	0.24	3.50	4.33	3.00	3.00	3.00	3.44	3.75
Extension															
Development of new extension strategies	2	4	58	84	48	200	**3.88**	0.06	3.81	4.01	**3.79**	3.75	3.81	**3.83**	**4.00**
Development of new training materials	2	4	60	82	46	198	3.86	0.06	**3.85**	**4.09**	3.62	**4.25**	**4.05**	3.81	3.96
Use of information and mobile telephony technologies	3	16	77	62	35	197	3.57	0.07	3.65	3.66	3.53	3.67	3.48	3.51	3.71
Others	0	3	2	7	2	28	3.57	0.27	3.33	3.75	3.00	3.00	NaN	3.55	3.67

[a] 1 = not important, 2 = low importance, 3 = important, 4 = very important, 5 = most important.

Source: Authors' survey.

Medium to low scores in the area of value chains, postharvest and marketing have been given to the improvement of root storage above and in ground on the farm (3.69 and 3.52) and to the development of sweetpotato products for animal feed (3.54). Research on gender-equitable value chains also ranks relatively low, with a mean score of 3.36. The improved management of residues and the production of ethanol received the lowest scores in that area, with mean values of 3.35 and 3.05, respectively.

Most of the options for socioeconomic, policy, and impact studies are ranked above the average of all research options, but the scores reached are not among the highest and do not reach into the high range. Further, the mean scores for most of these options are similar and the differences are hardly significant. Nonetheless, the two options with the highest scores in that area are the assessment of the impacts of sweetpotato research and development (3.81) and the assessment of the adoption of sweetpotato technologies (3.76). This shows that the respondents recognize the need for providing evidence about the impacts of their work. Work related to sweetpotato-based innovation systems (3.69), food and agricultural policies affecting sweetpotatoes (3.65), and the improvement of the policy framework for sweetpotato planting materials (mean score of 3.64) are considered by respondents to be of similar importance. Interestingly, the assessment of health effects of bio-fortified sweetpotatoes obtained a relatively low score (3.59, just around the median for all research options), although in particular breeding for pro-vitamin A scores very high in the respective section. Also, in spite of the constant presence of environmental and gender issues in the debate about agricultural research for development, both the assessment of health and environmental risks of the use of agrochemicals in sweetpotato systems (3.35) and the study of gender inequality in sweetpotato production systems (2.99) received only relatively low mean scores.

The final area of other options for sweetpotato research is extension. In this area, the development of new extension strategies, the development of new training materials, and the use of information technology (IT) and mobile telephony technologies for extension provided alternatives to be evaluated in the survey. The former two achieved moderately high mean scores of 3.88 and 3.86, respectively. The use of IT and mobile telephony scores significantly lower at 3.57.

4. Discussion and Conclusions

The results from the expert survey presented in this report provide insights into the perceptions of the sweetpotato community of practice about the priorities and needs for sweetpotato research and assess the relative importance of individual research options.

The first important observation is that a large share of the research options—almost 90% of them—are seen as important or very important. In fact, only nine of the research options have received a mean score lower than 3.0—that is, a score that would push the option into the area of low importance. The research options with low mean scores consist of breeding for cold tolerance/highland hardiness, the study of gender inequality in sweetpotato production systems, breeding for resistance to sweetpotato anthracnose, vegetable types, shade tolerance, resistance to moles and rats, and forage use. Breeding for low sugar content (non-sweet sweetpotatoes) is the lowest ranked research option (2.73).

At the other end of the spectrum, a number of front-runners can be identified (Table 9). In the survey, the improvement of the quality of planting material received the single highest mean score of all research options (4.35). This is consistent with previous work identifying a lack of sustainable seed

systems as a key constraint to improving sweetpotato productivity in Africa (Fuglie 2007) and recognizing the contribution of the provision of improved planting material to poverty alleviation through increased crop productivity (Barker et al. 2009).

TABLE 9: HIGHEST RANKED OPTIONS FOR SWEETPOTATO RESEARCH ACCORDING TO GLOBAL MEAN SCORE.

	All regions		*LAC*	*SSA*	*ESEA*	*SWCA*	*CGIAR*	*Male*	*Female*
	Mean score	*s.e. (mean)*	*Mean score*	*Mean score*	*Mean score*	*Mean score*	*Mean score*	*Mean score*	*Mean score*
Improving the quality of planting material (elimination of diseases, etc.)	**4.35**	0.05	**4.29**	**4.71**	**4.14**	4.25	4.48	**4.30**	**4.48**
Pro-vitamin A (beta-carotene) (breeding)	**4.28**	0.06	**4.21**	**4.70**	4.00	**4.50**	**4.52**	**4.20**	**4.51**
Breeding for high yield	**4.26**	0.06	**4.21**	4.61	**4.10**	4.00	4.42	**4.21**	4.41
Improving production and distribution of elite planting materials (formal seed systems)	4.21	0.05	**4.21**	4.46	**4.06**	4.50	4.35	4.19	4.27
SPVD (management)	4.18	0.07	3.93	**4.63**	4.02	3.50	**4.46**	4.14	4.36
Sweetpotato weevils (*Cylas formicarius*, *C. brunneus*, *C. puncticolis*) (management)	4.18	0.07	3.90	4.50	4.04	**4.50**	**4.50**	4.09	**4.44**
Sweetpotato weevil (breeding)	4.17	0.07	4.11	4.46	4.00	**4.50**	4.35	4.12	4.29
Improving shelf life of sweetpotato roots	4.16	0.06	4.04	4.38	4.05	**4.50**	4.32	4.12	4.27
Drought tolerance/water-use efficiency (breeding)	4.15	0.06	**4.29**	4.34	4.04	4.25	4.32	4.09	4.31
SPVD (breeding)	4.12	0.07	3.89	4.65	3.90	3.00	4.35	4.05	4.34
Developing sweetpotato products for human consumption	4.08	0.06	4.00	4.25	3.96	4.25	4.16	4.07	4.10
Early harvest (2.5–3 months after planting) (breeding)	4.06	0.06	4.07	4.16	3.98	**4.50**	4.35	4.01	4.15
…	…	…	…	…	…	…	…	…	…
Breeding for low sugar content (non-sweet) (LOWEST RANKED)	2.73	0.08	2.52	2.59	2.85	3.00	2.82	2.65	2.94

[a] 1 = not important, 2 = low importance, 3 = important, 4 = very important, 5 = most important.

Source: Authors' survey.

Breeding for high pro-vitamin A content is the next highest ranked option (4.28). While this result may in part reflect the fact (noted above) that many of the survey respondents are involved in work related to OFSP, it also backs earlier work on the potential role of sweetpotato to combat vitamin A deficiency (Burri 2011). Likewise, it corresponds to the high importance given by other authors to the development of varieties with improved nutritional qualities, in particular higher levels of beta-carotene (Fuglie 2007; Mukhopadhyay et al. 2011).

Outstanding importance has also been given to addressing SPVD and the sweetpotato weevil both through control and management and breeding. The fact that SPVD and weevils consistently receive high scores in both categories underlines the recognized high importance of these constraints for

sweetpotato production (Chalfant et al. 1990; Talekar 1982; Smit 1997; Sutherland 1986; Drok 2011; Carey 1996). Thus, the high ranking of virus diseases is also consistent with the importance given to high-quality planting material. Mukhopadhyay et al. (2011) highlight the use of clean and disease-free planting material as an option to control virus diseases and give highest importance to the improvement in availability and quality of planting material to ensure continued sweetpotato production in developing countries.

Further, highly ranked options related to the production of sweetpotato are breeding for high yields (4.26), drought tolerance and water-use efficiency (4.15), and early harvest (4.06). Whereas the result for high yields reflects the general desire to increase crop productivity, drought tolerance and earliness (through escape) point to the perceived strong role of biotic constraints to sweetpotato production.

Finally, two of the most highly ranked research options are related to the postharvest management of the sweetpotato crop. The ranking of the improvement of the shelf life of sweetpotato roots (4.16) takes into account the relevance of the reduction of postharvest losses. The high scores for the development of sweetpotato products for human consumption (4.08) illustrate the perceived need to offer new, attractive ways for sweetpotato consumption and to open up new channels for the marketing and commercialization of the crop.

Although highlighting only the research options with the highest global importance, Table 9 also points to differences in research priorities between regions and between male and female experts. In LAC, for example, breeding for drought tolerance appears to be of particularly high importance. Management and control of and breeding for SPVD, in turn, has a significantly lower score in LAC than in other regions and is even absent from the regional list of the highest ranked research options (Table 11 in Annex 3). However, the high ranking of the improvement of the quality of planting material points to the role of virus diseases as a production constraint also in that region. LAC is also the only region where the development of competitive sweetpotato value chains is a high priority. In ESEA, breeding for high pro-vitamin A content scores lower than in other regions, and SPVD also is considered less important. In SWCA, SPVD receives only low scores and does not appear in the regional priority list; whereas breeding for dual purpose use and the development of harvesting methods or machinery for planting and harvest are among the most important research options (Table 14, Annex 3). SSA is the only region where the improvement of technologies for farmer-based production and distribution of planting material (informal seed systems) is among the highest ranked research options (Table 12, Annex 3). This result probably is influenced by the current activity of corresponding research and development projects in that region. While a complete discussion of the regional differences in research priorities goes beyond the scope of this report, this short discussion already shows that priorities may and do differ between regions and that those differences will have to be taken into account when it comes to research planning at the regional and national levels. A more detailed analysis of the survey data to explore differences between regions and regional research priorities will be required.

With respect to gender, female sweetpotato experts tend to give higher scores on average than their male counterparts. Their ranking of research options, however, is similar. Given that differences between scores are only small and non-significant, it broadly corresponds to the ranking given by the male peers. However, as there is a demand to make priority-setting processes for agricultural research of development gender responsive (Meinzen-Dick et al. 2010), a more thorough analysis on gender differences in the prioritization of research options is indicated.

In this context, we once more emphasize that the three research options that incorporate gender aspects—namely gender-friendly labor-saving tools (mean score: 3.36; Table 6), research on more gender-equitable value chains (3.36; Table 8), and the study of gender inequality in potato production systems (2.29; Table 8)—are only given relatively low mean scores by the experts. This result is possibly a consequence of the mainly natural sciences background of the survey respondents. But it is also in contrast to the currently prominent position of gender issues in (parts of) the international agricultural research for development community (CGIAR Consortium 2011; CRP RTB 2013). And it raises the general question of how to assess options for research that rank low in the perception of the broader expert community but have a high and recognized importance within particular expert groups.

Finally, some qualification to the results presented in this report is still in order. First of all, the results convey a rather aggregate picture of the importance of the different constraints and research options. This implies that options that appear to rank low in this report may well have high importance in a particular locality or region or for particular target groups. Similarly, not everything given high importance by the respondents will provide a universal solution to be applied anywhere. The analysis takes a mainly global perspective, with some disaggregation according to regions and gender. A closer look may be necessary. It may not only be necessary to carry out more detailed and profound analysis with respect to regions and gender, but further analyses of differences in priorities by crop agro-ecologies, professions, disciplines, and other control variables recorded in the survey also promise to yield additional highly useful insights. Also, the open-ended questions on the top constraints to sweetpotato production and sector development included in the survey, as well as the responses to the questions on other research options in each technology section, have not been analyzed so far. In any case, the dataset generated through the survey and presented in this report constitutes an invaluable resource whose wealth of information with the present analysis has not been exploited to its fullest extent.

However, even at the current level of analysis, the global survey of options for sweetpotato research for development presented in this report provides important information and guidelines for the strategic planning of research endeavors that aim to provide global public goods and for creating large impacts through broad technology spillovers.

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ANNEXES

6. Annex 1. Timeline of expert survey

2012

March	First meeting of RTB priority assessment taskforce and plan to conduct expert surveys
June	Questionnaire developed by priority assessment taskforce and draft cassava questionnaire pre-tested during international cassava conference in Kampala
July–Sept.	Questionnaire adapted for sweetpotato survey and reviewed by team of sweetpotato experts
Sept.–Dec.	Questionnaire translated to Spanish and global sweetpotato expert survey set-up in online tool
Sept.	Survey carried out at meeting of sweetpotato breeders, Belgium, 7–9 September 2012; at the 3rd Annual Technical Meeting of the Sweetpotato for Profit and Health Initiative (SPHI), Nairobi, Kenya, 11–13 September 2012; and at the 16th International Symposium of the International Society for Tuber & Root Crops (ISTRC), Ibadan, Nigeria, 23–28 September 2012
Oct.–Dec.	Preparation of lists of sweetpotato experts for online surveys

2013

Jan.	Questionnaire translated into Chinese
Feb.	Invitations to participate in online survey sent to experts in China
June	Invitations to participate in online survey sent to experts Latin America, Africa, and Asia

Survey closes formally

Aug.	Analysis of survey data and writing of draft report
Dec.	Final report of global potato expert survey submitted to CRP RTB

7. Annex 2: Highest ranked options for sweetpotato research according to global mean score with Asia/Pacific as a single region

To ensure comparability with similar surveys on other crops carried out by CRP RTB, the following table presents the highest ranked options for sweetpotato research with a single region Asia/Pacific (APA) instead of the disaggregation of ESAE and SWCA.

TABLE 10: HIGHEST RANKED OPTIONS FOR SWEETPOTATO RESEARCH ACCORDING TO GLOBAL MEAN SCORE WITH APA AS A SINGLE REGION.

	All regions		*LAC*	*SSA*	*APA*	*CGIAR*	*Male*	*Female*
	Mean score	*s.e. (mean)*	*Mean score*	*Mean score*	*Mean score*	*Mean score*	*Mean score*	*Mean score*
Improving the quality of planting material (elimination of diseases, etc.)	**4.35**	0.05	**4.29**	**4.71**	**4.15**	4.48	**4.30**	**4.48**
Pro-vitamin A (beta-carotene) (breeding)	**4.28**	0.06	**4.21**	**4.70**	4.02	**4.52**	**4.20**	**4.51**
Breeding for high yield	**4.26**	0.06	**4.21**	4.61	**4.10**	4.42	**4.21**	4.41
Improving production and distribution of elite planting materials (formal seed systems)	4.21	0.05	**4.21**	4.46	**4.08**	4.35	4.19	4.27
SPVD (management)	4.18	0.07	3.93	**4.63**	4.00	**4.46**	4.14	4.36
Sweetpotato weevils (*Cylas formicarius*, *C. brunneus*, *C. puncticolis*) (management)	4.18	0.07	3.90	4.50	4.06	**4.50**	4.09	**4.44**
Sweetpotato weevil (breeding)	4.17	0.07	4.11	4.46	4.02	4.35	4.12	4.29
Improving shelf life of sweetpotato roots	4.16	0.06	4.04	4.38	4.07	4.32	4.12	4.27
Drought tolerance/water-use efficiency (breeding)	4.15	0.06	**4.29**	4.34	4.05	4.32	4.09	4.31
SPVD (breeding)	4.12	0.07	3.89	4.65	3.86	4.35	4.05	4.34
Developing sweetpotato products for human consumption	4.08	0.06	4.00	4.25	3.98	4.16	4.07	4.10
Early harvest (2.5–3 months after planting) (breeding)	4.06	0.06	4.07	4.16	4.00	4.35	4.01	4.15
…	…	…	…	…	…	…	…	…
Breeding for low sugar content (non-sweet) (LOWEST RANKED)	2.73	0.08	2.52	2.59	2.86	2.82	2.65	2.94

[a] 1 = not important, 2 = low importance, 3 = important, 4 = very important, 5 = most important.

Source: Authors' survey.

8. Annex 3: Highest ranked options for sweetpotato research according to regional mean scores

TABLE 11: HIGHEST RANKED OPTIONS FOR SWEETPOTATO RESEARCH ACCORDING TO LAC REGIONAL MEAN SCORE.

	All regions		*LAC*	*SSA*	*ESEA*	*SWCA*	*CGIAR*	*Male*	*Female*
	Mean score	*s.e. (mean)*	*Mean score*	*Mean score*	*Mean score*	*Mean score*	*Mean score*	*Mean score*	*Mean score*
Improving the quality of planting material (elimination of diseases, etc.)	4.35	0.05	4.29	4.71	4.14	4.25	4.48	4.30	4.48
Drought tolerance/water-use efficiency (breeding)	4.15	0.06	4.29	4.34	4.04	4.25	4.32	4.09	4.31
Breeding for high yield	4.26	0.06	4.21	4.61	4.10	4.00	4.42	4.21	4.41
Improving production and distribution of elite planting materials (formal seed systems)	4.21	0.05	4.21	4.46	4.06	4.50	4.35	4.19	4.27
Pro-vitamin A (beta-carotene) (breeding)	4.28	0.06	4.21	4.70	4.00	4.50	4.52	4.20	4.51
Sweetpotato weevil (breeding)	4.17	0.07	4.11	4.46	4.00	4.50	4.35	4.12	4.29
Developing sweetpotato products for industrial applications (puree, flour, and starch)	4.01	0.06	4.08	4.08	3.95	4.25	4.00	3.97	4.10
Development of competitive sweetpotato value chains	3.99	0.06	4.08	4.15	3.85	4.25	4.26	3.94	4.18
Early harvest (2.5–3 months after planting) (breeding)	4.06	0.06	4.07	4.16	3.98	4.50	4.35	4.01	4.15
Improving shelf life of sweetpotato roots	4.16	0.06	4.04	4.38	4.05	4.50	4.32	4.12	4.27
Phenotypic/molecular screening of landraces in search of high-value traits/new sources/tolerance/resistance to stress	3.90	0.06	4.04	4.02	3.80	4.25	3.95	3.83	4.07
Developing sweetpotato products for human consumption	4.08	0.06	4.00	4.25	3.96	4.25	4.16	4.07	4.10
…	…	…	…	…	…	…	…	…	…
Breeding for cold tolerance/highland hardiness (LOWEST RANKED)	2.99	0.08	2.52	3.20	3.12	3.25	3.36	2.96	3.14

[a] 1 = not important, 2 = low importance, 3 = important, 4 = very important, 5 = most important.

Source: Authors' survey.

TABLE 12: HIGHEST RANKED OPTIONS FOR SWEETPOTATO RESEARCH ACCORDING TO SSA REGIONAL MEAN SCORE.

	All regions		*LAC*	*SSA*	*ESEA*	*SWCA*	*CGIAR*	*Male*	*Female*
	Mean score	*s.e. (mean)*	*Mean score*	*Mean score*	*Mean score*	*Mean score*	*Mean score*	*Mean score*	*Mean score*
Improving the quality of planting material (elimination of diseases, etc.)	4.35	0.05	4.29	4.71	4.14	4.25	4.48	4.30	4.48
Pro-vitamin A (beta-carotene) (breeding)	4.28	0.06	4.21	4.70	4.00	4.50	4.52	4.20	4.51
SPVD (breeding)	4.12	0.07	3.89	4.65	3.90	3.00	4.35	4.05	4.34
SPVD (management)	4.18	0.07	3.93	4.63	4.02	3.50	4.46	4.14	4.36
Breeding for high yield	4.26	0.06	4.21	4.61	4.10	4.00	4.42	4.21	4.41
Improving technologies for farmer-based production and distribution of planting materials (informal seed systems)	4.01	0.06	3.82	4.53	3.68	4.00	4.57	3.90	4.31
Sweetpotato weevils (*Cylas formicarius*, *C. brunneus*, *C. puncticolis*) (management)	4.18	0.07	3.90	4.50	4.04	4.50	4.50	4.09	4.44
Improving production and distribution of elite planting materials (formal seed systems)	4.21	0.05	4.21	4.46	4.06	4.50	4.35	4.19	4.27
Sweetpotato weevils (breeding)	4.17	0.07	4.11	4.46	4.00	4.50	4.35	4.12	4.29
Improving shelf life of sweetpotato roots	4.16	0.06	4.04	4.38	4.05	4.50	4.32	4.12	4.27
Drought tolerance/water-use efficiency (breeding)	4.15	0.06	4.29	4.34	4.04	4.25	4.32	4.09	4.31
Breeding for high dry matter	4.01	0.07	3.63	4.30	3.92	4.25	4.16	3.98	4.17
…	…	…	…	…	…	…	…	…	…
Breeding for low sugar content (non-sweet)	2.73	0.08	2.52	2.59	2.85	3.00	2.82	2.65	2.94

[a] 1 = not important, 2 = low importance, 3 = important, 4 = very important, 5 = most important.

Source: Authors' survey.

TABLE 13: HIGHEST RANKED OPTIONS FOR SWEETPOTATO RESEARCH ACCORDING TO ESEA REGIONAL MEAN SCORE.

	All regions		*LAC*	*SSA*	*ESEA*	*SWCA*	*CGIAR*	*Male*	*Female*
	Mean score	*s.e. (mean)*	*Mean score*	*Mean score*	*Mean score*	*Mean score*	*Mean score*	*Mean score*	*Mean score*
Improving the quality of planting material (elimination of diseases, etc.)	4.35	0.05	4.29	4.71	4.14	4.25	4.48	4.30	4.48
Breeding for high yield	4.26	0.06	4.21	4.61	4.10	4.00	4.42	4.21	4.41
Improving production and distribution of elite planting materials (formal seed systems)	4.21	0.05	4.21	4.46	4.06	4.50	4.35	4.19	4.27
Improving shelf life of sweetpotato roots	4.16	0.06	4.04	4.38	4.05	4.50	4.32	4.12	4.27
Sweetpotato weevils (*Cylas formicarius*, *C. brunneus*, *C. puncticolis*) (management)	4.18	0.07	3.90	4.50	4.04	4.50	4.50	4.09	4.44
Drought tolerance/water-use efficiency (breeding)	4.15	0.06	4.29	4.34	4.04	4.25	4.32	4.09	4.31
SPVD (management)	4.18	0.07	3.93	4.63	4.02	3.50	4.46	4.14	4.36
Pro-vitamin A (beta-carotene) (breeding)	4.28	0.06	4.21	4.70	4.00	4.50	4.52	4.20	4.51
Sweetpotato weevils (breeding)	4.17	0.07	4.11	4.46	4.00	4.50	4.35	4.12	4.29
Early harvest (2.5–3 months after planting) (breeding)	4.06	0.06	4.07	4.16	3.98	4.50	4.35	4.01	4.15
Developing sweetpotato products for human consumption	4.08	0.06	4.00	4.25	3.96	4.25	4.16	4.07	4.10
Developing sweetpotato products for industrial applications (puree, flour, and starch)	4.01	0.06	4.08	4.08	3.95	4.25	4.00	3.97	4.10
…	…	…	…	…	…	…	…	…	…
Breeding for forage use	2.79	0.07	3.07	2.88	2.67	3.33	3.09	2.79	2.82

[a] 1 = not important, 2 = low importance, 3 = important, 4 = very important, 5 = most important.

Source: Authors' survey.

TABLE 14: HIGHEST RANKED OPTIONS FOR SWEETPOTATO RESEARCH ACCORDING TO SWCA REGIONAL MEAN SCORE.

	All regions		*LAC*	*SSA*	*ESEA*	*SWCA*	*CGIAR*	*Male*	*Female*
	Mean score	*s.e. (mean)*	*Mean score*	*Mean score*	*Mean score*	*Mean score*	*Mean score*	*Mean score*	*Mean score*
Improving production and distribution of elite planting materials (formal seed systems)	4.21	0.05	4.21	4.46	4.06	4.50	4.35	4.19	4.27
Pro-vitamin A (beta-carotene) (breeding)	4.28	0.06	4.21	4.70	4.00	4.50	4.52	4.20	4.51
Sweetpotato weevil (breeding)	4.17	0.07	4.11	4.46	4.00	4.50	4.35	4.12	4.29
Early harvest (2.5–3 months after planting) (breeding)	4.06	0.06	4.07	4.16	3.98	4.50	4.35	4.01	4.15
Improving shelf life of sweetpotato roots	4.16	0.06	4.04	4.38	4.05	4.50	4.32	4.12	4.27
Sweetpotato weevils (*Cylas formicarius*, *C. brunneus*, *C. puncticolis*) (management)	4.18	0.07	3.90	4.50	4.04	4.50	4.50	4.09	4.44
Breeding for dual purpose use	3.52	0.07	3.57	3.71	3.38	4.50	3.87	3.48	3.63
Harvesting methods or machinery for planting/harvesting	3.58	0.08	3.39	3.39	3.84	4.50	3.05	3.56	3.65
Soil salinity tolerance (breeding)	3.44	0.08	3.16	3.26	3.56	4.33	3.13	3.32	3.79
Improving the quality of planting material (elimination of diseases, etc.)	4.35	0.05	4.29	4.71	4.14	4.25	4.48	4.30	4.48
Drought tolerance/water-use efficiency (breeding)	4.15	0.06	4.29	4.34	4.04	4.25	4.32	4.09	4.31
Developing sweetpotato products for industrial applications (puree, flour, and starch)	4.01	0.06	4.08	4.08	3.95	4.25	4.00	3.97	4.10
…	…	…	…	…	…	…	…	…	…
Alternaria spp. (management)	3.23	0.07	3.19	3.33	3.30	1.67	3.05	3.12	3.52

[a] 1 = not important, 2 = low importance, 3 = important, 4 = very important, 5 = most important.

Source: Authors' survey.

9. Annex 4: Survey questionnaire

RESEARCH PROGRAM ON Roots, Tubers and Bananas
CGIAR

SURVEY OF PRIORITIES AND NEEDS FOR SWEETPOTATO RESEARCH – 2012/2013

Dear member of the sweetpotato community of practice, we appreciate you taking the time to complete the survey, even if you are not a researcher!

Section A. Please tell us a little about yourself

1. **Your name** (optional)**:** _____
2. **E-mail address** (optional for receiving study results)**:** _____
3. **Your gender** (please encircle)**:** **M** **F**
4. **Your age:** _____ years
   -
5. **Your Organization:** _____
   -
6. **How many years have you been involved, at least part-time, in sweetpotato research?** ____
7. **Would you characterize your sweetpotato work as**
   - ☐ Global
   - ☐ Regional (tick boxes)
   - ☐ Western and Central Africa
   - ☐ Eastern Africa
   - ☐ Southern Africa
   - ☐ North America
   - ☐ Central America and the Caribbean
   - ☐ South America
   - ☐ South-west and Central Asia
   - ☐ Southern Asia
   - ☐ Eastern Asia and Pacific
   - ☐ Europe

☐ Other (specify) _____

- ☐ National (specify country) _____

8. On which agro-ecological zones is your sweetpotato work focused? (tick all that apply)
☐ Tropical monsoon (*Am*)

☐ Tropical humid savannas environments (*Aw*) ☐ Subtropical humid environments (*Cfa, Cwa*)

☐ Tropical humid forest environments (*Af*) ☐ Tropical or subtropical Highlands (*Cwb)*

☐ Semi-arid environments (*Bwh, Bsh)*

☐ Others (specify) _____

9. In your opinion, what are the three top constraints to the sweetpotato sector today? (please rank and be specific; 1 is the highest possible rank)

1. _____
-
2. _____
-
3. _____

10. In your opinion, what will be the single one most important trend in sweetpotato in the next ten years?

_____

11. Are you (please mark the one most relevant answer)
☐ a research leader/manager from a national agricultural research institute?

☐ a research scientist from a national agricultural research institute?

☐ a research scientist or lecturer at a university?

☐ a student conducting research at a university?

☐ an extension agent?

☐ a representative of a non-government, not-for-profit organization (NGO)?

☐ a representative of a donor to the CGIAR system?

☐ a CGIAR center scientist?

☐ employed by a private, for-profit company?

☐ a policy maker or civil servant?

Other (please specify)?: _____

12. What is your background? (please mark all that apply)

☐ Crop genetic resources

☐ Genomics, bioinformatics, molecular biology

☐ Participatory plant breeding

☐ Plant breeding and conventional genetics

☐ Transgenic research

☐ Crop management, agronomy, and physiology

☐ Tissue culture

☐ Water management in crop production

☐ Soils/nutrient management

☐ Crop diseases and their management

☐ Cropping/farming systems

☐ Crop pests and their management

☐ Economics or policy

☐ Climate change specialist

☐ Nutrition

☐ Seed systems & virus management

☐ Monitoring and evaluation`

☐ Dissemination/technology transfer

☐ Harvest management, storage & transport

☐ Value chain development & management

☐ Cultural anthropology or rural sociology

☐ Training and knowledge management

☐ Research planning and administration

☐ Development planning and administration

☐ Other (please specify): _____

Section B. Please assess the importance of the following options for helping to reduce poverty and improve food security through sweetpotato research and capacity development.

Research options to reduce poverty and improve food security	**Importance for research** (please mark: 1=not important, 2=low importance, 3=important, 4=very important, 5=most important, don't know)
A Crop improvement	
1. Breeding for high yield	1 2 3 4 5 don't know
2. Breeding for high dry matter	1 2 3 4 5 don't know
3. Breeding for processing quality	1 2 3 4 5 don't know
4. Breeding for low sugar content (non-sweet)	1 2 3 4 5 don't know
5. Breeding for dual purpose use	1 2 3 4 5 don't know
6. Breeding for vegetable types	1 2 3 4 5 don't know
7. Breeding for forage use	1 2 3 4 5 don't know
8. Breeding for root form/shape	1 2 3 4 5 don't know
9. Nutrient use efficiency (specify)	1 2 3 4 5 don't know
10. Other (specify)	1 2 3 4 5 don't know
Breeding for improvements in nutritional quality	
11. Pro-vitamin A (beta-carotene)	1 2 3 4 5 don't know
12. Iron	1 2 3 4 5 don't know
13. Zinc	1 2 3 4 5 don't know
14. Retention of micronutrients during processing and storage	1 2 3 4 5 don't know
15. Anthocyanins (purple-fleshed) /antioxidants	1 2 3 4 5 don't know
16. Other (specify)	1 2 3 4 5 don't know
Breeding for biotic stress resistance	
17. Sweet Potato Virus Disease (SPVD)	1 2 3 4 5 don't know
18. Sweetpotato fungal diseases and root rots	1 2 3 4 5 don't know
19. Sweetpotato anthracnose	1 2 3 4 5 don't know
20. Sweetpotato nematodes	1 2 3 4 5 don't know
21. Sweetpotato weevil (*Cylas formicarius*, *C. brunneus*, *C. puncticolis*)	1 2 3 4 5 don't know

Research options to reduce poverty and improve food security	**Importance for research** (please mark: 1=not important, 2=low importance, 3=important, 4=very important, 5=most important, don't know)
22. Whiteflies and aphids	1 2 3 4 5 don't know
23. Moles and rats	1 2 3 4 5 don't know
24. Other biotic stresses of sweetpotato (specify)	1 2 3 4 5 don't know
Breeding for abiotic stress resistance	
25. Drought tolerance/water use efficiency	1 2 3 4 5 don't know
26. Cold tolerance/highland hardiness	1 2 3 4 5 don't know
27. Heat tolerance	1 2 3 4 5 don't know
28. Waterlogging	1 2 3 4 5 don't know
29. Tolerance of marginal/saline soils (specify)	1 2 3 4 5 don't know
30. Other abiotic stresses of sweetpotato (specify)	1 2 3 4 5 don't know
Breeding for environmental adaptation or new uses	
31. Early harvest (2.5–3 months after planting)	1 2 3 4 5 don't know
32. Medium maturity (6–8 months after planting)	1 2 3 4 5 don't know
33. Shade tolerance	1 2 3 4 5 don't know
34. Other (specify)	1 2 3 4 5 don't know
Other opportunities for crop improvement	
35. Germplasm enhancement and pre-breeding	1 2 3 4 5 don't know
36. Exploitation of heterosis	1 2 3 4 5 don't know
37. Improved accelerated breeding methods	1 2 3 4 5 don't know
38. Exploitation of molecular markers	1 2 3 4 5 don't know
39. Others (specify)	1 2 3 4 5 don't know
B Production technology, agronomy, crop management	
1. Improving soil fertility (micro-nutrients and fertilizer)	1 2 3 4 5 don't know
2. Managing soil acidity	1 2 3 4 5 don't know

Research options to reduce poverty and improve food security	**Importance for research** (please mark: 1=not important, 2=low importance, 3=important, 4=very important, 5=most important, don't know)
3. Managing soil salinity	1 2 3 4 5 don't know
4. Soil management and erosion control	1 2 3 4 5 don't know
5. Water management in crop production	1 2 3 4 5 don't know
6. Improving sweetpotato cropping systems	1 2 3 4 5 don't know
7. Harvesting methods or machinery for planting/harvesting	1 2 3 4 5 don't know
8. Gender-friendly labor-saving tools	1 2 3 4 5 don't know
9. Weed management and control	1 2 3 4 5 don't know
10. Others (specify)	1 2 3 4 5 don't know
C Planting materials, crop management	
1. Improving the quality of planting material (elimination of diseases, etc.)	1 2 3 4 5 don't know
2. Improving production and distribution of elite planting materials (formal seed systems)	1 2 3 4 5 don't know
3. Improving technologies for farmer based production and distribution of planting materials (informal seed systems)	1 2 3 4 5 don't know
4. Improving seed storage	1 2 3 4 5 don't know
5. Mass propagation methods, including tissue culture & hydroponics	1 2 3 4 5 don't know
6. Roots as source of "seed" material	1 2 3 4 5 don't know
7. Others (specify)	1 2 3 4 5 don't know
D Disease management, incl. resistant varieties	
1. Sweetpotato virus disease (SPVD)	1 2 3 4 5 don't know
2. Sweetpotato storage diseases	1 2 3 4 5 don't know
3. Alternaria spp.	1 2 3 4 5 don't know
4. Bacterial diseases (specify)	1 2 3 4 5 don't know
5. Others (specify)	1 2 3 4 5 don't know

Research options to reduce poverty and improve food security	**Importance for research** (please mark: 1=not important, 2=low importance, 3=important, 4=very important, 5=most important, don't know)
E Pest control and management, incl. resistant varieties	
1. White flies & aphids	1 2 3 4 5 don't know
2. Sweetpotato weevils (*Cylas formicarius, C. brunneus, C. puncticolis)*	1 2 3 4 5 don't know
3. Nematodes (specify kind)	1 2 3 4 5 don't know
4. Weeds	1 2 3 4 5 don't know
5. Others (specify)	1 2 3 4 5 don't know
G Genetic resource management	
1. In-situ genetic resource management	1 2 3 4 5 don't know
2. Collection, characterization (including DNA fingerprinting), evaluation, documentation (ex situ)	1 2 3 4 5 don't know
3. Phenotypic/molecular screening of landraces in search of high-value traits/new sources/tolerance/resistance to stress	1 2 3 4 5 don't know
4. Management of intellectual property rights and material transfer agreements	1 2 3 4 5 don't know
5. Other (specify)	1 2 3 4 5 don't know
6. Others (specify)	1 2 3 4 5 don't know
H Value chains, postharvest utilization, and marketing	
1. Improving shelf life of sweetpotato roots	1 2 3 4 5 don't know
2. Improving above-ground roots on-farm storage	1 2 3 4 5 don't know
3. Improving in-ground roots on-farm storage	1 2 3 4 5 don't know
4. Improving small-scale processing of sweetpotato for human consumption	1 2 3 4 5 don't know
5. Alternative on-farm utilization/processing for value addition	1 2 3 4 5 don't know
6. Developing sweetpotato products for human consumption	1 2 3 4 5 don't know
7. Developing sweetpotato products for industrial applications	1 2 3 4 5 don't know

Research options to reduce poverty and improve food security	**Importance for research** (please mark: 1=not important, 2=low importance, 3=important, 4=very important, 5=most important, don't know)
(puree, flour, and starch)	
8. Developing sweetpotato products for animal feed	1 2 3 4 5 don't know
9. Ethanol production from sweetpotato	1 2 3 4 5 don't know
10. Improve management of residues	1 2 3 4 5 don't know
11. Development of competitive sweetpotato value chains	1 2 3 4 5 don't know
12. Research on more gender equitable value chains	1 2 3 4 5 don't know
13. Development of farmer organizations and farmer clusters linked to markets	1 2 3 4 5 don't know
14. Others (specify)	1 2 3 4 5 don't know
I Socio-economic, policy, and impact studies on sweetpotato	
1. Assessment of small farmer access to new technologies	1 2 3 4 5 don't know
2. Assessment of sweetpotato technology adoption	1 2 3 4 5 don't know
3. Assessment of sweetpotato-based innovation systems	1 2 3 4 5 don't know
4. Assess impact of sweetpotato research and development	1 2 3 4 5 don't know
5. Assess health and environmental risks of herbicide and pesticide use in sweetpotato systems	1 2 3 4 5 don't know
6. Assess health effects of bio-fortified sweetpotato varieties	1 2 3 4 5 don't know
7. Study gender inequality in sweetpotato production systems	1 2 3 4 5 don't know
8. Research on food and agricultural policies affecting sweetpotato	1 2 3 4 5 don't know
9. Improving policy framework for sweetpotato planting materials (distribution, regulations, IPRs, etc.)	1 2 3 4 5 don't know
10. Others (specify)	1 2 3 4 5 don't know
J Extension	
1. Development of new extension strategies	1 2 3 4 5 don't know
2. Development of new training materials for extension	1 2 3 4 5 don't know
3. Use of information and mobile telephony technologies	1 2 3 4 5 don't know

Research options to reduce poverty and improve food security	**Importance for research** (please mark: 1=not important, 2=low importance, 3=important, 4=very important, 5=most important, don't know)
4. Others (specify)	1 2 3 4 5 don't know

Please add any comments here:

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