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Assessment on the perception of invasive alien Spices (IAS) of Farmers and Stake holders on the agricultural sector in eastern Ethiopia

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Abstract
Invasive species can be seen as species that are introduced in a new region, and that spreads rapidly. Invasive alien species (IAS) are characterized by rapid growth rates, extensive dispersal capabilities, large and rapid reproductive output and broad environmental tolerance. This assessment paper discuss on the general perception of IAS from three basic target groups (local farmers, both zonal, regional and woreda agricultural, environmental and forest experts). The assessment was based on three basic concepts that is (1). To understand the attitudes of the target group (evolution of the level of knowledge, awareness and need for information monitoring with related to invasive alien spices; (2). identifying the communication tools most frequently used; (and (3).identify which best practices were implemented in order to control IAS with in the residence area. From the assessment data we can understand all target group were concerning on the issue of IAS even they have different level of knowledge and control mechanism and finally the target groups forwarded the following basic recommendation like further support and cooperation with regard to its fast and aggressive expansion of IAS and I also support and elaborate their recommendation.

Keywords: Agricultural biodiversity, IAS, Impact, Target group, Perception

1. Introduction
Invasive species can be seen as species that are introduced in a new region, and that spreads rapidly [14]. Or an alien species is an organism introduced outside its natural past or present distribution range by human agency, either directly or indirectly [2]. The deliberate or accidental introduction of non-indigenous species to new habitats has become an increasingly important aspect of global environmental change [1, 10, 11, 13] and can cause important economic, environmental and social losses [4]. Invasive alien species (IAS) are characterized by rapid growth rates, extensive dispersal capabilities, large and rapid reproductive output and broad environmental tolerance [3]. It is estimated that as many as 50% of invasive species in general can be classified as ecologically harmful, based on their actual impacts [15]. Once an invasive species becomes firmly established, its control often becomes difficult and eradication is usually impossible [13]. Therefore, exotic species will forever be common components of every ecosystem on Earth.
Currently, IAS, which is the second, next to habitat distraction to biodiversity threat [8]. Therefore, countries should evaluate the ecological distribution and socioeconomic impact of these species to take appropriate management and control measures. In Ethiopia, there are about 32 IAS and from these 24 identified and 8 of them are still unidentified [12]. Among these invasive alien species Mesquites (*Prosopis juliflora*), parthenium weed (*Parthenium hysterophorus*), water hyacinth (*Eichhornia crassipes*), *Lantana cama*ra, and *Acacia* species are causing major problems in the country. Currently, it is observed that the IAS species has been increasing in density as well as area coverage from year to year even from month to month and heavily infests most agricultural as well as potential range lands in the eastern part of Ethiopia. The impacts of alien species are enormous. They cause alteration in ecosystem processes and community structure, decline in abundance and richness of native flora [5, 16, 17]. Since eastern part of Ethiopia is one of the country's hotspots for farmers indigenous Crop, animal and plant diversity but now a day this biological diversity is highly eroded and disappeared due to the occurrence and rapid invasion of invasive alien spice in the area.

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Communication is part of preventive actions on invasive alien species (IAS) which are recognized as much more effective than control actions because of a higher cost/benefit ratio from both an ecological and economical perspective [18]. But the success of communication lies in its aptitude in delivering a message and in changing behaviors. Determining the effectiveness of an awareness campaign through an appropriate monitoring is therefore a key component of every communication strategies. Surprisingly, such assessments are poorly documented in the literature dedicated to communication programs. Although it is logical and strongly recommended, in practice it is often forgotten [9] or underestimated. Results from such evaluation help in defining the communication actions which work or do not work, which communication channels or tools are most suitable. It also helps in determining if the message is received by the target audience and how it is perceived.

Therefore, this assessment was aims to address the following basic objectives (1). To understand the attitudes of the target group (evolution of the level of knowledge, awareness and need for information monitoring with related to invasive alien spices; (2). identifying the communication tools most frequently used; (3). To know the perception of the target population (farmers and stake holders) towards IAS and (4).identify which best practices were implemented in order to control IAS with in the residence area.

2. Materials and Methods
2.1. Sampling design
This assessment was addressed to farmers, agricultural, environmental and forest professionals from two zonal administration (East Hararghe zone and West Hararghe zone), Harari Regional State and Dire Dawa city administration in eastern Ethiopia. Three target groups were considered in this study: (1) local farmers; (2) zonal, regional and woreda agricultural experts; (3) Zonal, regional and woreda environment and forest experts (table 1).

Table 1: Target group

No.	Target group	Description
1.	Local farmers	Producers, consumers and sellers in agricultural crops
2.	Both zonal, regional and woreda agricultural experts	Civil servant in charge of agricultural areas working in municipalities
3.	Both zonal, regional and woreda environmental and forest experts	Civil servant in charge of environmental and forest working in municipalities

The assessment data were collected from local farmers and stake holders or experts through semi-structure questionnaire, face to face interview and focus group discussion based methods given by [7]. A total of 552 assessment data were collected from 552 interviewers (416 male and 136 female). From the total interviewers 480 (360 male and 120 female) were local farmers selected from 16 woreda (4 woreda from East haraghe, 4 woreda from West haraghe, 4 woreda from Harari regional state and 4 woreda from Dire Dawa city administration) and from each woreda a total of 30 local farmers were selected randomly based on their area and abundance on IAS around the area. And the reaming 72 (56 male and 16 female) 8 from the two zone (East and West hararghe zone), Harari regional State and Dire Dawa City administration from each 1 agricultural expert and 1 environment and forest expert and total of two from each and the rest 64 interviewers were from woreda experts and from each woreda 4 interviewer were selected purposefully based on their professional area of experts. The assessment was conducted from Aug, 2016 to Nov, 2016 at respondent's house and fields.

2.2. Data analysis
All data were analyzed in Access and Excel databases. Examples of questions are indicated in table 2. Basic statistics (# and %) were computed for each question [18].

Table 2: Examples of questions included during the assessment

Section	Question
1.Knowledge, understanding and concern	Do you know what is an invasive plant (or invasive alien plant)? If yes, what do you know? Do you know examples of invasive plants? According to you, what are the impacts of invasive plants? Do you think it is an important issue? Do you feel concerned by this issue?
2.Information and communication	Do you feel enough and already informed about invasive plants? If yes, by which communication channel(s)?
3.Best control practices of IAS were implemented	Do you have any control practice? If yes, what are those? Do you have any support based on the control method? What will be you recommendation based on controlling IAS?

Answers were compared with the definition of invasive species proposed in the Convention on Biological Diversity (2002) referred by [18], "*An invasive alien species is a species, sub-species or variety introduced by men outside its natural distribution area, able to survive, reproduce and spread in a new environment, which may cause environmental, economic,* *socio-cultural and/or public health impacts when established".* This definition highlights five main notions to refer concerning invasive plants: (1) spatial origin; (2) introduction by men; (3) naturalization; (4) expansion, spread and (5) impacts. The target group level of knowledge was evaluated following the criteria presented in table 3.

Table 3: Target group level of knowledge

Level of knowledge	Criteria
High	Those who answered "Yes" to the question "Do you know what an invasive plant is?" and indicated at least three notions of the definition and at least two correct examples and at least one impact.
Medium	Those who answered "Yes" to the question "Do you know what an invasive plant is?" and indicated at least one notion of the definition and/or at least one correct example.
Low	Those who answered "No" to the question "Do you know what an invasive plant is?" or those who answered "Yes" but indicated no notions and no examples and no impacts or those who answered "Yes" but indicated wrong examples.

3. Result
3.1. Perception of invasive alien plants
All the information and data based on the perception of IAS that is their knowledge, understanding and concern, the way that informed and communicated about the IAS and the method and practices that used by all target groups included in this assessment were present in the following table form.

3.1.1. Knowledge, understanding and concern

Table 4: Do you know what is an invasive plant (or invasive alien plant)?

Target group	Yes		No		No answer		Total	
	Nb	%	Nb	%	Nb	%	Nb	%
Local farmers	351	73.12	103	21.46	26	5.42	480	100
Zonal, Regional and Woreda agricultural experts	36	100	0	0	0	0	36	100
Zonal, Regional and Woreda environment and forest experts	36	100	0	0	0	0	36	100

Table 5: If yes, what do you know? *

Target group	Its origin		Way of introduced		Naturalization		Expansion		Impact on crop biodiversity		No answer	
	Nb	%	Nb	%	Nb	%	Nb	%	Nb	%	Nb	%
Local farmers	67	19.14	147	41.88	101	28.77	319	90.88	333	94.87	5	1.42
Zonal, Regional and woreda agricultural experts	24	66.67	29	80.56	31	86.11	36	100	36	100	0	0
Zonal, Regional and Woreda environment and forest experts	19	52.77	25	69.44	33	91.67	32	88.89	36	100	0	0

Note: - *indicated that n=351 for local farmers'=36 both zonal, regional and woreda agricultural, environment and forest experts.

Table 6: Do you know examples of invasive plants?

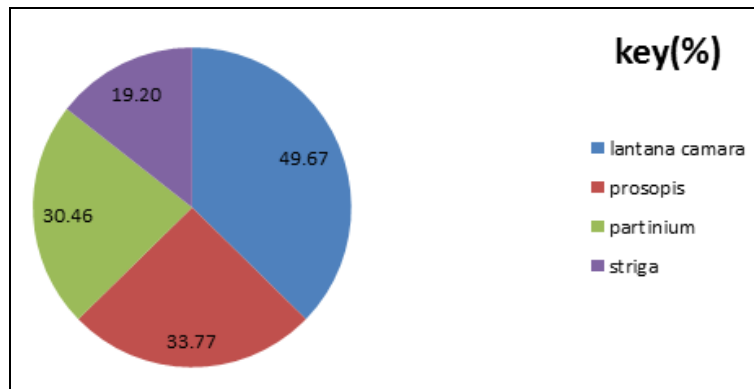| Target group	Yes		No		No answer		Total	
	Nb	%	Nb	%	Nb	%	Nb	%
Local farmers	302	62.92	133	27.70	45	9.38	480	100
Zonal, Regional and woreda agricultural experts	36	100	0	0	0	0	36	100
Zonal, Regional and Woreda environment and forest experts	36	100	0	0	0	0	36	100

Fig 1: major invasive plants cited by most of the respondent (top 4 species mostly cited)

Table7: What are the impacts of invasive plants?*

Target group*	Ecological		Economic		Human and animal health		On Biodiversity		No answer	
	Nb	%	Nb	%	Nb	%	Nb	%	Nb	%
Local farmers	119	33.90	192	54.70	97	27.64	114	32.48	4	1.14
Zonal, Regional and woreda agricultural experts	31	86.11	35	97.22	36	100	25	69.44	0	0
Zonal, Regional and Woreda environment and forest experts	36	100	29	80.56	27	75	32	88.89	0	0

Note: *: Among the respondents who answered yes to the question "do you know what is an invasive plant: n=351 for local farmers n=36 for both zonal, regional and woreda agricultural, environmental and forest experts.

Table 8: Do you think it is an important issue?

Target group	Yes		No		I don'tknow		No answer		Total	
	Nb	%	Nb	%	Nb	%	Nb	%	Nb	%
Local farmers	299	62.30	43	8.95	73	15.20	65	13.54	480	100
Zonal, Regional and woreda agricultural experts	36	100	0	0	0	0	0	0	36	100
Zonal, Regional and Woreda environment and forest experts	36	100	0	0	0	0	0	0	36	100

Table 9: Do you feel concerned by the issue?

Target group	Yes		No		I don't know		No answer		Total	
	Nb	%	Nb	%	Nb	%	Nb	%	Nb	%
Local farmers	363	75.63	12	2.50	41	8.54	64	13.33	480	100
Zonal, Regional and woreda agricultural experts	36	100	0	0	0	0	0	0	36	100
Zonal, Regional and Woreda environment and forest experts	36	100	0	0	0	0	0	0	36	100

3.1.2 Information and communication

Table 10: Do you feel enough and already informed about invasive plants?

Target group	Yes		No		I don'tknow		No answer		Total	
	Nb	%	Nb	%	Nb	%	Nb	%	Nb	%
Local farmers	189	39.38	167	34.80	83	17.30	41	8.52	480	100
Zonal, Regional and woreda agricultural experts	31	86.11	4	11.11	1	2.78	0	0	36	100
Zonal, Regional and Woreda environment and forest experts	26	72.22	7	19.44	2	5.56	1	2.78	36	100

Table 11: If yes, do you remember what was the communication channel used?

Communication channel	Local farmers		Zonal, Regional and woreda agricultural experts		Zonal, Regional and Woreda environment and forest experts	
	Nb	%	Nb	%	Nb	%
Conference	68	14.17	27	75	21	58.33
Internet	9	1.88	8	22.22	13	36.11
Article in press	27	5.63	11	30.56	7	19.44
Radio or TV reportage	79	16.46	3	8.33	2	5.56
Folders, brochures	0	0	4	11.11	10	27.78
Article in agricultural magazine	0	0	15	41.67	19	52.78
Other	402	83.75	29	80.56	23	63.89
I don't remember	3	0.63	0	0	0	0

Other communication channels used: through organizations (federation, association, etc.); through discussion with colleagues, through direct consultations (by phone, letter, Email); through training and/or qualification; through personal experience (observation in the field, personal interest) or personal contacts.

3.1.3. Control practices of IAS

Table 12: Do you have any control practice?

Target group	Yes		No		I don'tknow		No answer		Total	
	Nb	%	Nb	%	Nb	%	Nb	%	Nb	%
Local farmers	415	86.46	48	10	12	2.50	5	1.04	480	100
Zonal, Regional and woreda agricultural experts	34	94.44	2	5.56	0	0	0	0	36	100
Zonal, Regional and Woreda environment and forest experts	35	97.22	1	2.78	0	0	0	0	36	100

Table 13: If yes, what are those?

Control method	Local farmers		Zonal, Regional and woreda agricultural experts		Zonal, Regional and Woreda environment and forest experts	
	Nb	%	Nb	%	Nb	%
Cutting	383	79.80	16	44.44	22	61.11
Poling	174	36.25	17	47.22	19	52.78
Firing	63	13.13	13	36.11	11	30.56
Chemical	0	0	0	0	0	0
Biological	0	0	0	0	0	0
Use and avoid it	149	31.04	19	52.78	25	69.44
Preventing	56	11.67	23	63.89	24	66.67

Table 14: Do you have any support based on the control method?

Target group	Yes		No		No answer		Total	
	Nb	%	Nb	%	Nb	%	Nb	%
Local farmers	277	57.71	172	35.83	31	6.46	480	100
Zonal, Regional and woreda agricultural experts	19		17		0	0	36	100
Zonal, Regional and Woreda environment and forest experts	27		9		0	0	36	100

Note: these they said yes from the above table indicates that both governmental organization like Ethiopian Biodiversity institute, environment and forest authority as well as agricultural sectors and different non-governmental organization like care in Ethiopia, Menschen for Menschen are there most supporting organization regarding to control IAS on their locality.

Table 15: What will be you recommendation based on controlling IAS?

Recommendation that were raised by the target group	Local farmers		Zonal, Regional and woreda agricultural experts		Zonal, Regional and Woreda environment and forest experts	
	Nb	%	Nb	%	Nb	%
Get high attentions by government	324	67.50	30	83.33	17	47.22
Need all community participation	205	42.71	27	75	32	88.89
Including in education curriculum	12	2.5	16	44.44	12	33.33
Give high attention that both import and export materials	49	10.21	13	36.11	23	63.89
Get more awareness about its general characteristic	467	97.23	31	86.11	33	91.67
Linkage of institution	109	22.71	22	61.11	21	58.33

4. Discussion

4.1. Knowledge, understanding and concern

Generally from the above tables (4-9) we are understand that the target groups perception and understanding based on the type and even identification of IAS from indigenous pants, the knowledge what they know about IAS, major list of IAS indicated by the target group, understanding about the impact of IAS on different aspects, how much the issue was very hot issue on their area and even we can understand that their thinking how much feel on it and make it their concerning issue as well. The level of knowledge was evaluated by analyzing answers to questions related to the definition, impacts and examples of invasive plants (see material and methods). When we see the level of knowledge of the target group from the first table (table 4) of result part, especially the local farmers, most of them around 351 (73.12%) has the idea about IAS and from this we can understand that how much the issue becomes concerned and very critically serious issue on our agricultural biodiversity. The impact on crop biodiversity and rate of expansion are the two most characteristics that are known by most of the local farmers (table 5). And this indicates that the economic, ecological and loss of biodiversity are the most serious impact respectively due to introduction of IAS that understand by the local farmers (table 7). And both the zonal, regional and woreda agricultural, environment and forest experts are totally 72 (100%) of them they have the knowledge about IAs and also they are the concerned body on this regarding to aware the local farmers about its side effect both on agricultural biodiversity, ecological, forest, environment as well as the side effect of them on both human and animal health. And this is in agreement with the study that conducted in France, agricultural and environmental impact is also the most frequently cited by local farmers and nursery producers, public departments and garden contractors [6]. The most common IAS that were listed by both the local farmers and the experts were *lantana camara* (49.67%), *prosopis juliflora* (33.77%), *parthenium hysterophorus* (30.46%) and *striga spices* (19.20%) were the most dominated and highly affected on both agricultural biodiversity, ecology and also on human and animal health (Fig.1). In general we can understand from the data that were collected both from the local farmers as well as from experts the issue of IAS are very critical at all level and most of the local farmers 299 (62.30%) were indicated that this issue currently hot spot in all aspect (table 8). and most of them 363 (75.63%) of the local farmers and the whole experts 72 (100%) of them indicated that the issue needs the concern of the whole society, even not part of eastern area of the country. and it need the whole community cooperation in order to reduce and if it is possible eradicate from the area that were highly dominated and all its impacts (table 9).

4.2. Information and communication.

When I tried to asking to the target group how much they were informed on IAS, most of the target groups that was local farmers 189 (39.38%), agricultural experts 31(86.11%) and environment and forest experts 26 (72.225) of them were have enough and already informed about the general features of IAS (table 10). But even most of the target groups have enough information about IAS still most of them 167 (43.80%) of local farmers, 4(11.11%) agricultural experts and 7(19.44%) of environment and forest experts were they have not any information about IAS (table 10). From this we can understand that Still awareness creation with regard to IAS general features with in the community is the basic and highly needed as well as we should consider it the first serious point in order to prevent the impact of IAS. When we see the communication channels most frequently used in order to get information about IAS are (1) conferences or information sessions; (2) internet; (3) folders and brochures; (4) articles in agricultural magazines; (5) articles in press, (6) radio and TV reportage and (7) others (table 11). This indicates that respondents are generally informed through several communication channels. The communication channels used differ among the target groups. When we see the local farmers the most common communication channel that they used to get information about IAS were 402(83.75%) of them through personal experience that is from filed observation, 79(16.46%) of them were from radio and TV reportage and 68 (14.17%) of them were through different conference (table11). And when we see both agricultural and

environment and forest experts they were used different communication channels in order to get information about IAS as compared to local farmers and from this conferences and personal experience like training were the most common (table 11).from this we can understand than both local farmers and also the experts were mostly depends on social communication rather than internet and different article papers.so in order to addressed the information to the society again awareness creation through different training and conference should be taken as the leading point according to this assessment data.

4.3. Control practices of IAS
When we see from table 12 most of the target groups 415 (86.46%) of the local farmers, 34 (94.44%) of agricultural expert and almost all 35 (97.22%) of environment and forest experts were not only information about IAS rather they can developed and apply their own control mechanism since it is very critical and highly affected on both their economical, ecological as well as both human and livestock health. From the control methods that applied by the local farmer cutting 383 (79.80%), poling 174 (36.25%0 and use and avoid it 149 (31.04%) were the three most control methods respectively (table13).And when we see the experts recommendation on the control method of IAS preventing, use and avoid it, cutting and poling were the most and highly recommended control mechanism of IAS respectively as we see from table 13.

Based on the prevention and control system of IAS there were other collaborative and supportive both governmental and non-governmental organization. From the assessment data that were collected from this target group Ethiopian Biodiversity Institute, both regional, zonal and woreda agricultural, environment and forest authority were the supportive governmental organization and Care Ethiopian and Menschen for Menschen were the two most supporting non-governmental organization that work on awareness creation and control of IAs in Eastern part of Ethiopia (table 14).

Finally, from the target group the following basic recommendation were forwarded with regarding to IAS prevention, Control, avoid its impact on both economical, ecological, environmental and in general biodiversity lose aspect. There are Get high attentions by government, Need all community participation, Including in education curriculum, Give high attention that both import and export materials, Get more awareness about its general characteristic and Linkage of institution in order to prevent and manage the effect of IAS (table 15). From the above recommendation forwarded by the target group awareness creation with in the community was indicated as the most and the first chose in order to control and achieve total change on the impact of IAS followed by give high attention by the country government as we see from table 15.

5. Conclusion and Recommendation
This assessment was performed from three target groups a total of 552 respondents and the assessment was focused on the general knowledge (definition based on their own term, example, general features, issues and their concern) about IAS of the target group, their impact in all aspect especially on agricultural perspectives, the way to know how much they sense its impact and how to get the information about IAS and the method that they try to control in their locality as well as their internal idea what they need to do further on it. From assessment data II try to conclude is that all the target group

weather the experts as well as the local farmers they have knowledge about IAS and currently IAS become the first and the most Serious problem that affected on their agricultural biodiversity, range lands, ecology and even their health. And they have their own control mechanism that mostly tries to control the distribution and impact of IAS and there is also some supporting organization with them based on Control method on it. Finally they also recommend further support and cooperation with regard to its fast and aggressive expansion of IAS and from these data I also recommend that in order to achieve effective and fruitful effect on the eradication and control of IAS both governmental and non-governmental organization even at individual level do more on awareness creation and try insert strong internal idea the community how much they are danger in all our life if we cannot control and eradicate it.

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