



Choosing the best cowpea varieties appropriate for the Central-Eastern region of Burkina Faso using PROMETHEE methods

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Abstract. Decisions on the choice of varieties to be planted in a region are delicate because they can have positive or negative long-term consequences on the economic, environmental and nutritional level of a country. For this reason, a multi-criteria decision making (MCDM) based approach is proposed to conduct this choosing process. The proposed approach first of all makes it possible to identify alternatives, i.e. agricultural varieties, criteria with their weighting and evaluation process, in interaction with the stakeholders in the production-processing-consumption food chain. Afterward, PROMETHEE method (I and II) is used to aggregate the preference information stemming from the structuring process and make it possible to choose the best agricultural varieties suitable for a given region. An Application for the selection of suitable cowpea varieties for the Central-Eastern region of Burkina Faso is made to demonstrate the implementation and effectiveness of our approach. As a result, the varieties KVx442-3-25SH (Komcallé) and Yiis-Yandé emerged as the best choices of suitable cowpea varieties for the Central-Eastern region of Burkina Faso.

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1. Introduction

The problem of choosing the right agricultural variety for a given region involves several stakeholders: selection teams or units, producers, processors and consumers. The selection

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team is made up of scientists who work in the laboratories to create new agricultural varieties. They often use crossbreeding of different species or genetic modification of a basic variety [20]. Generally, after authorization by the competent authorities, for the exploitation of one or more agricultural varieties, it is with the producers that the said varieties are found for large-scale production. Once the production from the variety has been marketed by the producers, this production either arrives directly at the consumers or is first processed by the processors before being made available to the consumers in several forms. It is therefore understood that a variety of crop to be suitable for a given region must not only have the physical potential adapted to the soil of the region, but must also be acceptable to the final consumer. This is where processors come in to deal with organoleptic and nutritional issues. Hence the character of the multi criteria decision making problem (MCDM) conferred on the problem of choosing the best crop varieties adapted to a given region.

Agriculture is now one of the foundations of Burkina Faso's economy. Indeed, the Environmental Institute for Agricultural Research (INERA) is working to make several varieties available for each agricultural species in order to satisfy the stakeholders in the field. Among these many species, there is cowpea (*Vigna unguiculata*), which is the main staple food in Burkina Faso. Choosing better cowpea varieties adapted to a given region increases agricultural yield, which further contributes to the region's economic development and food self-sufficiency. In view of this major challenge, our objective is to propose a multi-criteria decision making (MCDM) based approach to conduct this choosing process. Specifically, we propose to implement the MCDM's principles of structuring and evaluating namely [12, 17]:

- (i) identify the different stakeholders (selection team, Producers, Processors, consumers);
- (ii) define the different alternatives or actions (agricultural varieties of a given species *e.g.* cowpea);
- (iii) identify the relevant criteria for evaluating alternatives;
- (iv) evaluate the alternatives w.r.t. criteria;
- (v) aggregate the preference information and choose the best agricultural varieties using Preference Ranking Organization METHod for Enrichment of Evaluations (PROMETHEE I and II).

The rest of the article is as follows. Section two deals with the methodology of implementing our approach for the case study. Section three presents the PROMETHEE I and II methods. In section four, we implement our approach to address the problem of choosing better cowpea varieties in the central-eastern region of Burkina Faso. Finally, the last section is devoted to the conclusion and prospects for future work.

2. Methodology

The starting point was the literature review on cowpea culture and the structuring and evaluation of the MCDM process. Through this literature review, the various stakeholder groups were identified. Work groups were organized to give stakeholders a clear understanding of the problem of choosing the best crop varieties adapted to a given region and the approach we propose to solve it.

Interactions with each stakeholder group allowed us to identify alternatives and relevant criteria that reflected their preferences and constraints. We also obtained from them the preference information, on the one hand for the weighting of the criteria based on the revised card method of [18] and [9] and on the other hand for the evaluation of the alternatives w.r.t. these criteria.

In order to aggregate the preference information stemming from the structuring of the problem, we have chosen the Preference Ranking Organisation Methods for Enrichment Evaluation (PROMETHEE [2, 21]). Indeed, PROMETHEE is a MCDM method widely used for the evaluation of agricultural yield [11], sustainability of cultural systems [19] or land use for agricultural activities [14]. Its relative simplicity makes it easily understood even by non-expert stakeholders involved in a decision-making process. Performance on qualitative or quantitative criteria is handled by the PROMETHEE method. Therefore, the PROMETHEE method is more appropriate for questions of agricultural variety choice than a weighted sum method; one of the main shortcomings of the latter is the "blind" compensation of poor performance by good performance. Note that there are several variants of the PROMETHEE method (PROMETHEE I, II, III, V [6]).

3. Presentation of PROMETHEE method

PROMETHEE method was developed by [5] and is actively used and considered as an efficient MCDM ranking method. It is a method that makes it possible to construct a valued outranking relation that reflects an intensity of preference. It makes pairwise comparisons between alternatives and measures the intensity $P_j(a, b)$ of preference of one a over the other a on each criterion g_j by means of a preference function $F_j(d_j(a, b))$ where $d_j(a, b)$ represents the difference in the evaluations $g_j(a) - g_j(b)$ on criterion g_j . For a given criterion g_j , a value $P_j(a, b) = 0$ reflects the non-preference of alternative a over alternative b ; a value $P_j(a, b) = 1$ reflects the strong preference of a over b ; intermediate values increasing between 0 and 1 reflect a weak and then increasing preference for option a . Formally, the following equalities and inequality hold:

$$P_j(a, b) = F_j(d_j(a, b)) \quad (1)$$

$$d_j(a, b) = g_j(a) - g_j(b) \quad (2)$$

$$0 \leq P_j(a, b) \leq 1 \quad (3)$$

The pair $\{g_j(\cdot), P_j(a, b)\}$ is called *generalized criterion* associated to criterion g_j . The implementation of the method can be reduced to the execution of four main steps: generalized criterion selection, determination of an outranking relation, preference assessment

and exploitation of the value of the outranking relation. One of the main advantages of this method over other outranking MCDM methods such as ELECTRE methods[12, 17] is the relatively small number of parameters it requires. It is therefore easier to implement. In addition, this method is fairly easy to understand and supports both qualitative and quantitative criteria. These are all reasons that can explain the successful use of the PROMETHEE methods in several sectors such as the environment[15], medical diagnosis[7], networks and telecommunications[8], energy[10], water[1]. In the following we are interested in the PROMETHEE I and II methods and give the main steps.

3.1. Choice of generalized criteria type

Each criterion g_1, g_2, \dots, g_n will be associated with a generalized criterion chosen on the basis of a preference function and scale effects will be eliminated. Six types (I,II,III,IV,V,VI) of generalized criteria are available[5, 6]. In choosing the appropriate type of generalized criteria, a number of facts must be considered. Indeed, when actions are evaluated on real numbers measured on linear scales, the criterion of type V is better indicated because it involves an area of indifference and a strict preference area; and if the decision-maker does not wish in this case to take into account an area of indifference, type III is recommended. If the data are qualitative and measured on discrete scales, type IV is the most appropriate; if the decision-maker wishes to consider a positive degree of preference even if the difference between two actions is small (resp. zero), type II (resp. I) is more appropriate. And if he wishes to see his degree of preference increase continuously as the difference increase, he can choose criterion VI. In connection with our case study, we present only the generalized criteria IV (used for qualitative criteria) and V (used for quantitative criteria)

3.1.1. Generalized criterion of Type IV

In this type of generalized criterion, two parameters are to be set by the decision-maker: the preference threshold p and the indifference threshold q . Two actions a and b are considered indifferent when the difference between $g_j(a)$ and $g_j(b)$ remains less than or equal to q . If this difference is between p and q , then the weak preference holds and beyond that there is strict preference. It is defined as follows:

$$F(d) = \begin{cases} 0 & \text{if } d \leq q \\ \frac{1}{2} & \text{if } q < d \leq p \\ 1 & \text{if } d > p \end{cases} \quad (4)$$

3.1.2. Generalized criterion of Type V

In this case, a and b are considered to be indifferent as long as the difference between $g_j(a)$ and $g_j(b)$ does not exceed q . Above this threshold, the degree of preference increases linearly with $d_j(a, b)$ until it reaches a strict preference threshold p . As before, the decision-maker must set two thresholds: the preference threshold and the indifference threshold.

The mathematical formulation is as follows:

$$F(d) = \begin{cases} 0 & \text{if } d \leq q \\ \frac{d-q}{p-q} & \text{if } q < d \leq p \\ 1 & \text{if } d > p \end{cases} \quad (5)$$

Once the preference functions are determined, the different outranking relations are then determined.

3.2. Determination of an Outranking relation

Outranking relation allows the strength of alternatives to be assessed in order to rank them from best to worst.

3.2.1. Preference index

To each criterion g_j let us associate its function of preference P_j and its weight w_j also called relative importance with respect to the other criteria. For each couple (a, b) of alternatives,

$$\pi(a, b) = \sum_{j=1}^m w_j P_j(a, b) \quad (6)$$

$$\text{with } \sum_{j=1}^m w_j = 1 \quad (7)$$

defines the preference index expressing the degree of preference of alternative a over b

3.2.2. Outranking flows

Denote A the set of alternatives and we note $n = |A|$, where $|A|$ is the cardinal of A . The three outranking flows are defined by the equation 8.

$$\begin{cases} \phi^+(a) = \frac{1}{n-1} \sum_{x \in A} \pi(a, x) & \text{outgoing flow} \\ \phi^-(a) = \frac{1}{n-1} \sum_{x \in A} \pi(x, a) & \text{incoming flow} \\ \phi(a) = \phi^+(a) - \phi^-(a) & \text{net flow} \end{cases} \quad (8)$$

. The outgoing outranking flow $\phi^+(a)$ allows to evaluate (measure) the strength of the a alternative against the $n-1$ other alternatives, while the incoming outranking flow allows to measure the weakness of the a alternative compared to the $n-1$ other alternatives. The net outranking flow ($\phi(a)$) refers to the difference between the outgoing flow and the incoming flow. This net outranking flow allows to define a total preorder in the set A of alternatives as we will see later.

3.3. Exploiting of the outranking relation[3]

Flows are used to analyze the results. Indeed, they undergo two particular mathematical treatments defining the outranking relations of PROMETHEE I and PROMETHEE II.

3.3.1. PROMETHEE I: partial ranking

The partial ranking of PROMETHEE I, $(P^{(I)}, I^{(I)}, R^{(I)})$, is obtained from the outgoing and incoming outranking flows as follows:

$$\left\{ \begin{array}{l} aP^{(I)}b \text{ if } \left\{ \begin{array}{l} \phi^+(a) > \phi^+(b) \text{ and } \phi^-(a) < \phi^-(b) \text{ or} \\ \phi^+(a) = \phi^+(b) \text{ and } \phi^-(a) < \phi^-(b) \text{ or} \\ \phi^+(a) > \phi^+(b) \text{ and } \phi^-(a) = \phi^-(b) \end{array} \right. \\ \\ aI^{(I)}b \text{ if } \phi^+(a) = \phi^+(b) \text{ and } \phi^-(a) = \phi^-(b) \\ \\ aR^{(I)}b \text{ if } \left\{ \begin{array}{l} \phi^+(a) > \phi^+(b) \text{ and } \phi^-(a) > \phi^-(b) \text{ or} \\ \phi^+(a) < \phi^+(b) \text{ and } \phi^-(a) < \phi^-(b) \end{array} \right. \end{array} \right. \quad (9)$$

$P^{(I)}, I^{(I)}, R^{(I)}$ represent respectively preference, indifference and incomparability. The possible results of the comparison of two actions will therefore be as follows:

- $aP^{(1)}b$, a is preferred to b ; a is in this case more *powerful* and less *weak* than b . The information provided by the outranking flows is in the same direction and can be considered reliable. In this case, it is realistic to declare a is preferred to b
- $aI^{(1)}b$, a and b are indifferent. The power and weakness of a and b are equal, so there is no way to objectively separate a and b .
- $aR^{(1)}b$, a and b are incomparable. That is, the realities presented by a and b are totally different so that it is not possible to compare them objectively

Finally the best alternative(s) is(are) one(those) that is(are) not outranked by any other alternatives

3.3.2. PROMETHEE II: complete ranking

PROMETHEE II will be used if you want to have a complete ranking $(P^{(II)}, I^{(II)})$ of all the actions. This ranking is obtained by ranking the actions in decreasing order of net flows ϕ . Then we will have:

$$aP^{(II)}b \iff \phi(a) > \phi(b) \quad (10)$$

$$aI^{(II)}b \iff \phi(a) = \phi(b) \quad (11)$$

where $P^{(II)}$ and $I^{(II)}$ refer respectively to preference and indifference in the sense of PROMETHEE II. Note that PROMETHEE II does not take into account incomparability. The information provided by the complete preorder of PROMETHEE II is easier to interpret, but is less rich than that provided by PROMETHEE I.

4. Application for the choice of the best cowpea varieties

In this part a real case study is conducted. Recall that we want to select the best cowpea varieties adequate for the Center-East region of Burkina Faso. For this end, as mentioned in section 2 our approach is participatory and closely aligned with the MCDM approach[16]. So the main stakeholders have been identified and grouped into four class, namely: INERA's cowpea varieties selection team, producers, processors and consumers. In interaction with them sixteen alternatives (*i.e.* cowpea varieties) and ten criteria have been identified.

4.1. Identification of cowpea varieties

In Burkina Faso, several varieties of cowpea have been popularized by INERA's cowpea varieties selection team. Among this wide range of cowpea varieties, we have identified sixteen varieties by mutual agreement with INERA's cowpea varieties selection team: KVx30-309-6G (A_1), KVx396-4-4(A_2), KVx396-4-5-2D(A_3), KVx402-5-2(A_4), KVx414-22-2(A_5), KVx442-3-25SH(Komcallé, A_6), KVx61-1(Bengsiido) (A_7), KVx745-11P(A_8), KVx771-10G(Nafi, A_9), KVx775-33-2G(Tiligré, A_{10}), Melakh(A_{11}), Niizwe(A_{12}), Telma(A_{13}), TVx3236(A_{14}), Yiis-Yandé(A_{15}), Gorom local(A_{16}).

4.1.1. Identification of criteria

The criteria that will be used to evaluate the alternatives are obtained from a survey we conducted among INERA's cowpea varieties selection team, producers, processors and consumers. This survey identified ten criteria (see Table 1) based on production and seed quality constraints.

4.2. Evaluation of alternatives w.r.t. criteria and Weighting of criteria

4.2.1. Criteria measurement scale

In order to evaluate the alternatives w.r.t. the selected criteria, we associate to each criterion a measurement scale Thus the adopted measurement scales are grouped in Table 2.

- Note that the performance of the alternatives w.r.t. criteria C_2, C_4, C_5, G_1 and G_2 was already available thanks to the work carried out by the Centre National d'Etudes Vétérinaires et Alimentaires (CNEVA) of Burkina Faso.
- The evaluation of alternatives w.r.t. criteria C_1, C_3, G_3 and G_5 was carried out by joint quotation with INERA's cowpea varieties selection team:

Table 1: Objectives - Sub-objectives - Criteria

Objectives	Sub-objectives	Criteria
Improve cowpea production	Fight diseases and find short cycle varieties	striga reaction(C_1) Cycle-semi-maturity(C_2)
	Seed productivity	Type of plant(C_3) Potential yield(C_4) Weight of 100 seeds(C_5)
Satisfy producers, processors and consumers	Improve seed quality	Seed length(G_1) Seed width(G_2) Seed texture(G_3) Seed colour(G_4)
	Organoleptic property	Taste of the seed(G_5)

- for the C_1 criterion, they considered it appropriate to give a score of "2" for striga resistance, which in their opinion represents the best varieties; a score of "1" for varieties that tolerate striga and a score of "0" for striga sensitivity; in other words, any striga-sensitive varieties should be excluded for the Center-East region;
 - for the C_3 criterion, the selected varieties are either erected or semi-erected. Erect varieties are preferred over semi-erect varieties, hence the respective quote of "2" and "1";
 - following the same principle applied to G_3 criterion, we obtained a quote of "2" for the wrinkled texture variety and a quote of "1" for the smooth texture variety;
 - for the G_5 criterion, the unsweetened taste was given a quote of "2" because it is the best preferred and the sweet taste a quote of "1" because it is the least preferred.
- The performance of the alternatives w.r.t. G_4 criterion was obtained through a survey conducted by [20]. The survey revealed that out of a sample of 67 respondents in the Central East region, 87% prefer white, 10% white-brown, and 3% brown.

4.2.2. Performance matrix

We have summarized the results of the evaluation of the different alternatives in the performance matrix illustrated in Table 3.

Table 2: Criteria measurement scale

Criteria	Nature	Scale
C_1	Qualitative	Resistance $\rightarrow 2$ Tolerance $\rightarrow 1$ Sensitivity $\rightarrow 0$
C_2	Quantitative	$[0; \infty[$
C_3	Qualitative	Erected $\rightarrow 2$ Semi-Erected $\rightarrow 1$ Crawling $\rightarrow 0$
C_4	Quantitative	$[0; \infty[$
C_5	Quantitative	$[0; \infty[$
G_1	Quantitative	$[0; \infty[$
G_2	Quantitative	$[0; \infty[$
G_3	Qualitative	Wrinkled $\rightarrow 2$ Smooth $\rightarrow 1$
G_4	Quantitative	white $\rightarrow [0; 1[$ White-brown $\rightarrow [0; 1[$ brown $\rightarrow [0; 1[$
G_5	Qualitative	Sweetened $\rightarrow 1$ Unsweetened $\rightarrow 2$

4.2.3. Weighting of criteria

The Simos card method [18] in its revised version by Roy and Figueira [9] is used to determine the weighting coefficients. These weightings are summarized in Table 4. This method has already been used with success for applications in the environmental field [12, 13, 22]. Since the criteria were subdivided into two independent groups (see Table 1) of equal importance, we first determined the weights in each of the two groups. Then, each sub-weight was multiplied by the weight of the sub-group to which it belongs (*i.e.* by $\frac{1}{2}$)

4.3. Aggregation of the performance matrix and recommendation

This subsection is devoted to the construction and exploitation of the outranking relation of the PROMETHEE I and II methods.

4.3.1. PROMETHEE outranking flows of the case study

For each quantitative (resp. qualitative) criterion, we have associated a generalized criterion or preference function of type V (resp. IV) as explained in section 3.1; the indifference threshold q and strict preference threshold p have been obtained by the formulas:

$$\begin{cases} p = 10\% [\max(g(a_i)) - \min(g(a_i))] \\ q = 5\% [\max(g(a_i)) - \min(g(a_i))] \end{cases} \quad (12)$$

Table 3: Performance matrix

	C_1	C_2	C_3	C_4	C_5	G_1	G_2	G_3	G_4	G_5
Optimization	Max	Min	Max	Max	Max	Max	Max	Max	Max	Max
A_1	2	70	1	1.5	18.1	7.56	3.68	2	0.87	2
A_2	0	70	1	1.5	14.6	8.17	4.55	2	0.87	2
A_3	1	70	1	1.5	13.3	7.38	5.21	2	0.87	2
A_4	2	70	1	1.5	15	8.99	4.10	2	0.87	2
A_5	0	70	1	1.5	18.2	8.14	4.64	2	0.87	2
A_6	1	60	2	1.75	20.8	9.27	4.82	2	0.87	2
A_7	2	70	2	1.5	12.5	7.73	3.91	2	0.10	1
A_8	2	70	2	0.6	12.7	7.36	4.35	2	0.87	2
A_9	1	70	2	1.5	18.9	10.9	5.33	2	0.87	2
A_{10}	1	70	2	1.56	20.7	8.57	4.85	2	0.87	2
A_{11}	2	60	2	1.5	14.7	6.14	2.94	2	0.87	2
A_{12}	2	60	2	0.75	15.1	7.82	4.52	2	0.87	2
A_{13}	0	60	1	0.9	16.3	9.95	4.01	2	0.03	2
A_{14}	0	65	2	1	13.3	5.72	4.17	2	0.87	2
A_{15}	2	60	2	1.4	19.3	9.28	5.55	2	0.87	2
A_{16}	2	75	2	1.5	16	8.55	4.02	1	0.03	1

assuming, without loss of generality, that all criteria are to be maximized. The visual PROMETHEE software [4] made it possible to highlight the outranking flows computed for each alternative as shown in Table 5.

The exploitation of these flows leads to PROMETHEE I and II ranking.

4.3.2. Results and discussion

PROMETHEE I ranking

The exploitation of the outranking flows ϕ^+ , ϕ^- , allows to obtain the following results:

- Identification of several effective alternatives (*i.e.* that are not outranked by any other alternatives). Therefore, the alternatives A_{15} and A_6 represent the best cowpea varieties suitable for the central-eastern region of Burkina Faso;
- several alternatives are incomparable between them. Among them, the alternative with the most incomparability with the other alternatives is A_{13} alternative. A_{13} is incomparable with seven alternatives. For example,

– A_{10} is preferred to A_{13} because,

$$\begin{cases} \phi^+(A_{10}) = 0.3528 > \phi^+(A_{13}) = 0.2802 \\ \phi^-(A_{10}) = 0.1682 < \phi^-(A_{13}) = 0.4376; \end{cases} \quad (13)$$

Table 4: Criteria weighting

Criteria	Weight (%)
C_1	13
C_2	17.5
C_3	2.5
C_4	8.5
C_5	8.5
G_1	8
G_2	8
G_3	2.5
G_4	18.5
G_5	13

– A_{13} is incomparable to A_1 because

$$\begin{cases} \phi^+(A_{13}) = 0.2802 > \phi^+(A_1) = 0.2494 \\ \phi^-(A_{13}) = 0.4314 > \phi^-(A_1) = 0.2357; \end{cases} \quad (14)$$

In order to separate the two best alternatives obtained by the PROMETHEE I ranking, and thus obtain a complete ranking of all the alternatives (with the possibility of indifference between alternatives), we continued with the PROMETHEE II ranking.

PROMETHEE II ranking

PROMETHEE II ranks the alternatives following the decreasing values of net flows(ϕ); this results in the ranking showed in Table 5. We find the alternative A_{15} at the top of the complete PROMETHEE II ranking followed by A_{16} , which alternatives are among the two best alternatives given by the PROMETHEE I ranking. However, PROMETHEE II eliminates all incomparabilities even in situations where the comparison is very difficult: this is the case for example for the alternatives A_{15} and A_6 (resp. A_{10} and A_{12}) which have very close net flows and which are declared incomparable by the PROMETHEE I method.

Recommendation

The results of the PROMETHEE I and PROMETHEE II treatments show a similarity in the choice of the best suitable cowpea varieties for the central-eastern region of Burkina Faso. Thus the varieties KVx442-3-25SH (Komcallé, A_6) and Yiis-Yandé (A_{15}) are the best choices of cowpea varieties that we recommend to be popularized in the Central East region. In particular, PROMETHEE II ranked A_{15} in first place and A_6 in second place. But given the small difference in net flow values between them, the information given by PROMETHEE I that A_{15} and A_6 are incomparable is to be considered. So, if we were to choose between these two alternatives, rather than choosing A_{15} directly based on the PROMETHEE II method, we would have to investigate the issue further by examining them more closely. For example, an additional relevant criterion to be met could be introduced in order to distinguish more objectively between the alternatives A_{15} and A_6 .

Table 5: PROMETHEE flows and PROMETHEE II Ranking

Actions	ϕ^+	ϕ^-	ϕ	PROMETHEE II ranking
A_1	0.2432	0.2357	0.0075	8
A_2	0.1965	0.30052	-0.1087	11
A_3	0.2237	0.2899	-0.0662	10
A_4	0.2153	0.3494	-0.1341	13
A_5	0.2319	0.2748	-0.0429	9
A_6	0.5094	0.0978	0.4116	2
A_7	0.1432	0.4483	0.3051	3
A_8	0.1958	0.3202	-0.1244	12
A_9	0.3611	0.1599	0.2011	4
A_{10}	0.3528	0.1682	0.1846	5
A_{11}	0.3234	0.2066	0.1168	7
A_{12}	0.3585	0.1808	0.1776	6
A_{13}	0.2802	0.4314	-0.1512	14
A_{14}	0.2257	0.4218	-0.1961	15
A_{15}	0.4920	0.0775	0.4145	1
A_{16}	0.2060	0.5912	-0.3852	16

5. CONCLUSION

The work carried out under this article is intended to help the authorities in charge of agriculture and the stakeholders in the food chain production-processing-consumption to choose one or more varieties of cowpea adapted to the Central-Eastern region. Given the complexity of the decision of choice, we used an MCDM approach based on the PROMETHEE I and II methods. Thus the selection process required, first of all, the identification of the main stakeholders concerned (INERA's cowpea varieties selection team, producers, processors, consumers), potential alternatives (cowpea varieties), the main criteria for comparison and their weight. Sixteen (16) cowpea varieties provided by INERA's cowpea varieties selection team were evaluated on their ability to satisfy the ten criteria reflecting the requirements of the chosen study area, the Central East Region of Burkina Faso. Finally, the varieties KVx442-3-25SH (Komcallé, A_6) and Yiis-Yandé (A_{15}) emerged as the best choices of suitable cowpea varieties for the Central-Eastern region of Burkina Faso. This choice has also received the approval of the stakeholders concerned, which reassures us as to the relevance of our approach and its adequacy for providing a solution to the problems addressed.

In perspective, other MCDM methods could be used to solve the problem of choosing suitable cowpea varieties for the same or another given region and the results from these different methods can be compared. In addition, the proposed approach can be replicated, by redefining the criteria, for the choice of other types of crop varieties (rice, maize, etc.) appropriate to a given region.

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