







Uncovering the determinants of attitudes towards true cost accounting for food: a study with Swiss residents

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ABSTRACT

The true cost accounting for food (TCAF) methodology was developed to quantify the environmental, social and health externalities associated with food systems, from production to consumption. One possible implementation consists of changing the current prices on the supermarket shelves to reflect the true prices (i.e. adding the true costs to market prices), incentivizing a transition to more sustainable food systems. Understanding the knowledge and attitudes of consumers towards TCAF is key to informing potential implementation, as attitudes exert influence on behaviour. In this context, this study analysed the determinants of a positive attitude towards TCAF in Switzerland. An online survey was conducted in Switzerland in June 2024 and included questions on the true cost approach, true price, general food choice motives and sociodemographic characteristics. Data from 224 respondents were analysed. Results indicated low previous knowledge of TCAF among Swiss residents. However, after providing some information on the approach, respondents showed a positive attitude towards TCAF and true price implementation to reduce health, environmental and social externalities. Results from regression analysis suggest that trust in TCAF and true price methodologies strongly influenced the positive attitudes towards TCAF. The sense of environmental protection was also associated with a positive attitude. Moreover, participants with more positive attitudes towards TCAF tend to give more importance to paying for the externalities of food compared to affordability issues. This study is a first step to better understand the acceptability and feasibility of implementing TCAF and true price in Switzerland, from consumers' point of view. Actors along the food value chain can use this information to support the transition towards more sustainable food systems.

1. Introduction

The current agri-food systems need to be improved to more sustainable ones, by reducing their impact on climate change, the environment and biodiversity, while also considering economic and social dimensions [1–4]. Moreover, the population's diet should be shifted to more nutritious and sustainable ones, such as by increasing plant-based and local foods consumption and reducing the intake of animal-based products and foods with high levels of added sugar [2,5], being more aligned to the nutritional guidelines. These measures are expected to enhance the quality of life of the population, where levels of obesity and malnutrition, as well as non-communicable diseases, increase in many countries. In this context, the United Nations [6] proposed, among the Sustainable Development Goals (SDGs), goals and actions aiming to

transform and improve the world food system and food consumption patterns [5]. In the same way, a recent report from the Food and Agriculture Organization of the United Nations revealed the “true cost accounting” approach as a viable tool to transform agrifood systems for the better by uncovering hidden impacts of these systems on our health, environment, etc [7].

The true cost accounting approach aims to uncover and account for the hidden costs that originate from unsustainable, unhealthy and socially inadequate practices [5,8]. According to Hendriks et al. [5], these hidden effects of unhealthy and unsustainable foods (e.g.: soil pollution, unhealthy diet rich in added sugar, sodium or trans fats and underpaid workers) make these foods more profitable while healthy and sustainable foods are more expensive to produce and consume.

By uncovering, monetising, and accounting for environmental, social

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and health externalities, a more sustainable food system with fewer environmental burdens, better working conditions for the employees and healthier food products for the consumers can be achieved. However, to be effective, this approach is expected to work with the common efforts of governments, stakeholders and consumers [5,9–12]. Governments can support the implementation of TCAF by integrating it into the policy and budget. TCAF can inform policy making, for example, for the repurposing of agricultural public support to encourage the production of healthier and more sustainable food. Businesses can work, for example, on minimizing negative externalities and improving the value chain, as well as offering transparency to consumers by including TCAF on food labels. Consumers can make conscious food choices after being informed about the externalities of food [5,13]. Moreover, Hendriks et al. [5] suggested for the involved players of the food system (government, stakeholders), ways to engage in the true cost accounting approach such as building a new discipline on the topic to educate business and government professionals and provide tools to help true cost accounting implementation. According to the authors, integrating the true cost in product labelling can also be effective in educating consumers. Perotti [14] mentioned that communicating TCAF through campaigns and labels, as well as investing in education (from kindergarten to higher education), can increase consumer awareness of externalities impact and may contribute to the Swiss food system transformation. TCAF should also take in consideration that the low-income population should have guaranteed access to healthy diets and the costs of externalities should not lie completely on consumers to avoid monetary constraints, and negative impact on societal welfare, for example [2,5,15].

One possible implementation is to change the current prices depending on their true costs (i.e. true pricing). Besides the current price of food on supermarket shelves and shopping bills, additional costs such as “diet-related diseases” and “natural capital degradation” are incurred in hidden ways [10]. Products with “true pricing” will have integrated the externalities into their prices. This will be paid for by consumers. With the true price available on supermarket shelves, the private food sector will be incentivized to produce food with fewer negative externalities, and consumers will, at the same time, be encouraged to make healthier and sustainable choices [8,13]. In addition, the extra price paid for certain foods can remediate the negative effect of the externalities or be invested in more sustainable food production [8]. Consumers are important stakeholders along the food chain, who often remain unaware of the externalities, leading to unsustainable consumption patterns [16]. For the successful implementation of TCAF, it is vital to understand how consumers would perceive the true cost accounting for food approach and true price implementation, besides their knowledge, personal choices, and behaviour patterns [8,15].

The “true cost accounting for food” and “true pricing” are new concepts. To the best of our knowledge, there are limited data on consumer perceptions and attitudes toward true cost accounting for food worldwide [8,15,17,18] and in Switzerland [14]. The limited literature has also reported on consumers’ behaviour towards the true price of food approach. Michalke et al. [15] revealed a willingness of some consumers to pay 100 % of the true price for certain foods and reluctance to pay the true price for other foods (e.g.: more expensive foods with higher negative externalities accounted for). Taufik et al. [8] reported perceived green value (positive environmental impact) and perceived social status as significant predictors of purchase intention of true-price food by Dutch consumers. According to the study, this result was influenced by the level of trust of consumers in the true price characteristics and organisations involved in the implementation of the approach. Literature also reported that interest in environmentally friendly practices and healthier foods is directly related to more sustainable food consumption [19,20]. Moreover, literature reports the role of attitude in influencing consumer behaviour as described in the theory of value-attitude-behaviour [21] and the theory of planned behaviour [22,23]. While Taufik et al. [8] explored consumer perception and

acceptance of true price food products, the present study aims to uncover the factors that influence consumer attitudes towards the true cost of food approach, including true pricing. Furthermore, in addition to the common factor of trust, we also sought to explore different contributing factors that have not been evaluated in the previous literature, such as affordability importance and true price effect on consumption.

Therefore, in the present study, the dependent variable will be “attitude towards TCAF”. We also hypothesise that “trust” in the true cost methodology and the interest in “natural content of food”, “environmental protection” and “general health” will act as drivers to the “positive attitude towards TCAF”. These variables are related to healthier and more sustainable consumption patterns, which are in line with the objectives of the TCAF approach [8,19,20]. For this reason, we will also apply the constructs “trust in TCAF”, “green trust (trust true price characteristics)”, “general health interest”, “natural content”, “local and seasonal” and “environmental protection” as independent variables in the regression model.

By shedding light on the factors influencing a positive attitude towards the true cost and by evaluating consumers’ perceptions towards the true cost and true price, we aim to enrich the current available literature and inform a larger data collection at a national level. To the best of our knowledge, this is the first study to uncover consumer perceptions and attitudes towards the true cost and true price by applying this methodology in the Swiss context.

Therefore, this study aims to: 1) measure consumers’ level of knowledge on TCAF and 2) analyse the determinants for a positive attitude towards the TCAF in the Swiss population. A better understanding of consumer knowledge, perceptions and attitudes will enable the development of targeted strategies to promote more informed and sustainable purchasing decisions and could contribute to the implementation of this methodology in Switzerland.

2. Methods

2.1. Survey and participants

In June 2024, a link to a survey was sent by email to a sample of 788 German-speaking Swiss panel members. These panel members were recruited through previous studies in which a flyer was sent by post to a representative sample. Participants had two weeks to answer the survey. The response rate was 30.1 % (n = 237). During data cleaning, cases that failed the instructional manipulation check were removed, leading to a final sample size of N = 224 (Table 1).

2.2. Measures

At the beginning of the questionnaire, participants answered questions regarding diet type (Omnivore: with meat, fish and/or seafood; Flexitarian: mainly vegetarian with occasional meat or fish consumption; Vegetarian: no meat, fish or seafood consumption or Vegan: without animal products), followed by previous knowledge towards true cost accounting for food and environmental, social and health externalities and trust in TCAF (Fig. 1).

Before the items on “previous knowledge” and “trust in TCAF” related to true cost accounting for food (constructs 1–3, Table 2; 6-point Likert scale) the following information was shown: “*Did you know that there are multiple environmental (e.g. biodiversity loss, soil degradation), social (e.g. underpayment, child labour) and health costs (e.g. obesity, malnutrition) associated with food? These costs are currently not accounted for. The main goal of the method of True Cost Accounting for Food is to uncover these hidden costs and to offer consumers a more transparent view of the products they buy and consume. Through this survey, we want to study the understanding, perception, and attitudes of the Swiss residents towards True Cost Accounting for Food (TCAF). It is not necessary to have already heard about TCAF to fill out the questionnaire. Even without experience, you certainly have an opinion on the subject, and it is this view that interests us.*

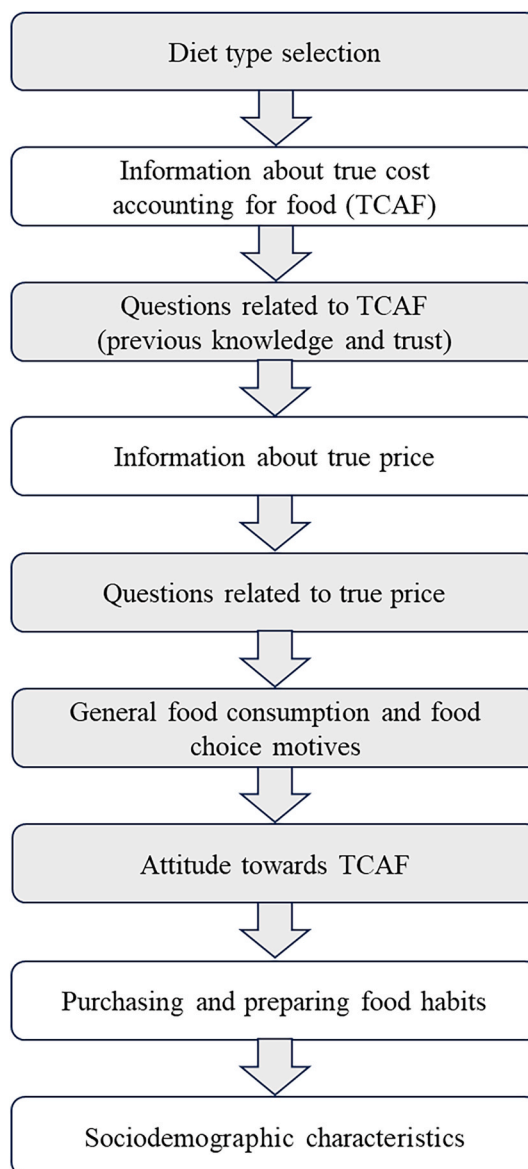
Table 1
Sociodemographic characteristics of respondents (N = 224).

Characteristics		%
Sex	Female	59.4
	Male	40.6
Age	18–39 years old	10.7
	40–59 years old	36.6
	>60 years old	52.7
Nationality	Swiss	94.2
	Other	5.8
Diet type	Omnivore	54.5
	Flexitarian	35.3
	Vegetarian	6.3
	Vegan	4.0
Education	Mandatory school	2.2
	Secondary level II (vocational education)	15.6
	Secondary level II (general education)	4.9
	Tertiary degree (higher vocational education)	36.2
Employment status	Tertiary degree (Applied school/University)	41.1
	Full-time ($\geq 90\%$)	25.9
	Part-time (50–89%)	22.8
	Part-time (<50%)	10.7
Household net income	Not working	40.6
	I don't want to answer/don't know	12.1
	Less than 3000 CHF	4.5
	3000–4500 CHF	8.0
	4501–6000 CHF	16.5
	6001–7500 CHF	14.7
	7501–9000 CHF	12.9
	9001–10,500 CHF	10.7
More than 10,500 CHF	20.5	
Responsible for buying food	Me	57.6
	Someone else	4.5
	Me together with someone else	37.9
Responsible for preparing the meals	Me	56.3
	Someone else	13.4
	Me together with someone else	30.4

How much do the following statements apply to you?"

Before the items related to the “true price applied to food” (constructs 4–7, Table 2; 6-point Likert scale) were queried, the following statement was presented: “The prices of food items we see on supermarket shelves do not reflect the various externalities and their cost. In fact, these costs are currently paid by individuals or the society as a whole. For example, the cost of unhealthy eating and the associated diseases is paid by the whole population through health insurance costs and poses an important economic burden to individuals (income loss due to ill health for instance). Likewise, the use of too many pesticides that might contaminate drinking water, which would then have to be treated at great expense, is paid for by society. The concept of the “True Price of Food” accounts for the cost of food including all these externalities. The price for a product on the shelf in a supermarket would then reflect the true price. For some products, this price would be higher than today, for healthy and sustainable products this price could be lower than today. The one generating the externalities should pay for them. However, some of this could be transferred to consumers. Having to pay the true price can make healthy and sustainable products more attractive in terms of price and lead to a healthier and more sustainable society. How much do the following statements apply to you?”. These definitions were based on the literature available [2,8,12,14].

Next, participants were invited to answer questions on general food consumption and food choice motives (constructs 8–15, Table 2; 6-point Likert scale), followed by “attitude towards true cost accounting for food” (construct 16, Table 2; semantic differential scale), their habits for purchasing and preparing food and sociodemographic characteristics (Table 1). A 6-point Likert scale was used throughout the survey to avoid non-opinion options ([24]; Lucas et al., [20,25,26]).

**Fig. 1.** Survey structure.

2.3. Statistics

All analyses were performed using IBM SPSS Statistics (v.29). In order to assign the items referring to TCAF and true price variables into dimensions explaining the patterns of correlations and common themes (constructs 1 to 7 from Table 2), exploratory factor analyses were conducted (Table 3) applying the principal component method for extraction and varimax rotation, following Field [35].

Next, the reliability of all constructs in Table 2 was checked using the Cronbach's α results (Table 2). Most of the scales showed reliability results higher than 0.7, which is satisfactory. Four of them had a Cronbach's α between 0.65 and 0.69; however, as they are mostly validated and frequently used scales, we decided to keep them in the analyses [36].

Descriptive statistics were applied to reveal the average results for each construct (Table 4). T-test and ANOVA (followed by post hoc test) were used to explore significant ($p < 0.05$) differences in the scores of scales 1 to 7 (true cost and true price related) among different groups e. g.: sex (female/male), diet type (omnivores/flexitarians/vegans or vegetarians), and education level (mandatory to secondary, tertiary vocational and tertiary University). Significant differences were shown

Table 2
Scales and items used in the survey.

Constructs/scales	Cronbach's Alpha
True cost accounting related	
1. Previous knowledge of TCAF (Based on [20]) I've already read/heard about the TCAF method. I noticed that TCAF was presented in the media.	0.78
2. Previous knowledge of externalities (Based on [20]) I already knew about the environmental costs associated with food. I already knew about the social costs associated with food. I already knew about the health costs associated with food.	0.86
3. Trust in TCAF (new; inspired by [27]) I believe TCAF will uncover hidden costs for the benefit of the population's health. I believe TCAF will uncover hidden costs for the benefit of the environment. I think TCAF will be successfully implemented in the Swiss context.	0.80
True price related	
4. Concerns for the national economy (new; inspired by [27]) Selling foods at the true price reduces the competitiveness of Switzerland. Selling foods at the true price puts tourism in Switzerland at risk. Selling foods at the true price lowers the exportation of goods by Switzerland.	0.78
5. True price effect on consumption (new; inspired by [27]) If the price of chocolate increases due to the "True Price" concept, my consumption will be reduced. If the price of meat increases due to the "True Price" concept, my consumption will be reduced. If the price of vegetables decreases due to the "True Price" concept, my consumption will increase.	0.69
6. Affordability importance (new; inspired by [27]) For me, affordability is more important when deciding to buy food than paying for social externalities. For me, affordability is more important when deciding to buy food than paying for health externalities. For me, affordability is more important when deciding to buy food than paying for environmental externalities. I do not think it is fair to incorporate the costs of externalities in the price. If I have the choice, I will buy products at true price only if they become cheaper than today.	0.93
7. Green trust (trust true price characteristics) [8] I trust that the true prices are calculated correctly. I trust that revenues will indeed be used to solve problems in the environmental and social domains. I trust that investments will be made in agricultural companies where the food products are made so that the hidden costs will decrease there.	0.93
General food consumption/Food choice motives	
8. General health interest [28] The healthiness of food has little impact on my food choices. ^b I am very particular about the healthiness of the food I eat. I eat what I like and I do not worry much about the healthiness of food. ^b	0.69
9. Price/quality relation [29] I always try to get the best quality for the best price. I compare the prices between product variants in order to get the best value for money. It is important for me to know that I get quality for all my money.	0.65
10. Price criteria [29] I always check prices even on small items. I notice when products I buy regularly change in price. I look for ads in the newspaper for store specials and plan to take advantage of them when I go shopping.	0.77
11. Food involvement [30] I don't think much about food each day. ^b Talking about what I ate or am going to eat is something I like to do. I enjoy cooking for others and myself. I care whether or not a table is nicely set.	0.66
12. Environmental protection^a [31] Has been prepared in an environmentally friendly way.	0.91

Table 2 (continued)

Constructs/scales	Cronbach's Alpha
Is packaged in an environmentally friendly way. Has been produced in a way which has not shaken the balance of nature.	
13. Local and seasonal^a [32] Is a local/regional product. Is a seasonal product. Comes from close by (little transport distance).	0.91
14. Natural content^a [33] Contains no additives. Contains natural ingredients. Contains no artificial ingredients.	0.92
15. Familiarity^a [33] Is what I usually eat. Is familiar. Is like the food I ate when I was a child.	0.80
Dependent variable	
16. Attitude towards TCAF (Based on [20,34]) "In general, I think that the method of TCAF is ..." not interesting - interesting not to be applied - to be applied not to be supported - to be supported Negative – positive	0.93

Legend.

Note: Scales/constructs 1–7 were obtained through exploratory factor analyses (see sections 2.3 and 3.1). Scales 1–15 ranging from 1- strongly disagree to 6- strongly agree (1-strongly disagree, 2-disagree, 3-somewhat disagree, 4-some-what agree, 5-agree and 6-strongly agree). Scale 16 "Attitude towards TCAF" was queried as a semantic differential scale varying from – 3 to +3 (without 0) and during data treatment recoded to a scale from 1 to 6.

^a Introductory statement: "It is important to me that the food I eat on a typical day:"

^b Reversed for analyses.

in Fig. 2.

Then, multiple linear regression analyses using the Backward method were applied following Giacomuzzo et al. [19], Lucas et al. [37] and Lucas and Brunner [25]. The Backward method is a stepwise regression that begins with a full model (where all the variables are entered) and gradually eliminates variables from the regression model at each step to obtain a reduced model with relevant predictors. Significant predictors ($p < 0.05$) affecting a positive attitude towards TCAF were retained in the model (Table 5). Attitude towards TCAF was used as a dependent variable while the other 15 variables (constructs 1–15, Table 2) and sociodemographic (sex, age, diet type, education and employment status) were initially included in the model as independent variables. The results of the correlation matrix and the collinearity diagnostics indicated no concern regarding multicollinearity [35]. By checking the analysis of variance, the model was considered significant fit to the data overall. In addition, variance inflation factors and the tolerance statistics were close to 1 and well above 0.2, respectively.

3. Results

3.1. Factor analysis

Exploratory factor analysis was applied to uncover the underlying common dimensions correlated with our TCAF and true price items. Table 3 shows the eigenvalues and % of variance obtained in the initial analysis and the factor loadings after rotation. In the initial analyses, seven factors had eigenvalues above the Kaiser criterion of 1, which together explained 77.3 % of the variance. The inflexion points on the scree plot confirmed the presence of seven components. Kaiser-Meyer-Olkin (KMO), anti-image correlation, Bartlett's test, and communalities values showed no cause for concern [35].

Table 3
Exploratory factor analysis on items related to true price and true cost (N = 224).

Factors and corresponding items	Loadings ^a	Eigenvalues	% of Variance
Factor 1. Affordability importance ($\alpha = 0.93$)		5.87	26.70
For me, affordability is more important when deciding to buy food than paying for social externalities.	0.91		
For me, affordability is more important when deciding to buy food than paying for environmental externalities.	0.89		
For me, affordability is more important when deciding to buy food than paying for health externalities.	0.89		
If I have the choice, I will buy products at true price only if they become cheaper than today.	0.81		
I do not think it is fair to incorporate the costs of externalities in the price.	0.74		
Factor 2. Green trust ($\alpha = 0.93$)		2.93	13.31
I trust that revenues will indeed be used to solve problems in the environmental and social domains.	0.92		
I trust that investments will be made in agricultural companies where the food products are made so that the hidden costs will decrease there.	0.90		
I trust that the true prices are calculated correctly	0.88		
Factor 3. Previous knowledge of externalities ($\alpha = 0.86$)		2.54	11.56
I already knew about the social costs associated with food.	0.89		
I already knew about the health costs associated with food.	0.86		
I already knew about the environmental costs associated with food.	0.85		
Factor 4. Concerns for the national economy ($\alpha = 0.78$)		1.73	7.87
Selling foods at the true price reduces the competitiveness of Switzerland.	0.85		
Selling foods at the true price lowers the exportation of goods by Switzerland.	0.82		
Selling foods at the true price puts tourism in Switzerland at risk.	0.73		
Factor 5. Trust in TCAF ($\alpha = 0.80$)		1.49	6.77
I believe TCAF will uncover hidden costs for the benefit of the population's health.	0.83		
I believe TCAF will uncover hidden costs for the benefit of the environment.	0.82		
I think TCAF will be successfully implemented in the Swiss context.	0.58		
Factor 6. True price effect on consumption ($\alpha = 0.69$)		1.34	6.10
If the price of meat increases due to the "True Price" concept, my consumption will be reduced.	0.85		
If the price of chocolate increases due to the "True Price" concept, my consumption will be reduced.	0.83		
If the price of vegetables decreases due to the "True Price" concept, my consumption will increase.	0.62		
Factor 7. Previous knowledge of TCAF ($\alpha = 0.78$)		1.09	4.96
I noticed that TCAF was presented in the media	0.90		
I've already read/heard about the TCAF method	0.88		

Note.

^a Rotated factor loadings.**Table 4**
Descriptive statistics of the independent variables (N = 224).

Scales used as independent variables in the regression model	Mean	SD
True Cost Accounting related		
1. Previous knowledge of TCAF		
I've already read/heard about the TCAF method.	2.07	1.13
I noticed that TCAF was presented in the media.	2.03	1.28
I noticed that TCAF was presented in the media.	2.12	1.20
2. Previous knowledge of externalities		
I already knew about the environmental costs associated with food.	4.24	1.17
I already knew about the environmental costs associated with food.	4.13	1.35
I already knew about the social costs associated with food.	4.08	1.32
I already knew about the health costs associated with food.	4.50	1.29
3. Trust in TCAF		
I believe TCAF will uncover hidden costs for the benefit of the population's health.	4.15	0.88
I believe TCAF will uncover hidden costs for the benefit of the population's health.	4.40	1.04
I believe TCAF will uncover hidden costs for the benefit of the environment.	4.58	1.08
I think TCAF will be successfully implemented in the Swiss context.	3.47	1.01
True price related		
4. Concerns for the national economy		
Selling foods at the true price reduces the competitiveness of Switzerland.	3.40	1.02
Selling foods at the true price reduces the competitiveness of Switzerland.	3.58	1.27
Selling foods at the true price puts tourism in Switzerland at risk.	2.77	1.19
Selling foods at the true price lowers the exportation of goods by Switzerland.	3.87	1.20
5. True price effect on consumption		
If the price of chocolate increases due to the "True Price" concept, my consumption will be reduced.	3.09	1.09
If the price of chocolate increases due to the "True Price" concept, my consumption will be reduced.	2.76	1.23
If the price of meat increases due to the "True Price" concept, my consumption will be reduced.	3.19	1.47
If the price of meat increases due to the "True Price" concept, my consumption will be reduced.	3.32	1.45
If the price of vegetables decreases due to the "True Price" concept, my consumption will increase.	3.32	1.45
6. Affordability importance		
For me, affordability is more important when deciding to buy food than paying for social externalities.	2.47	1.09
For me, affordability is more important when deciding to buy food than paying for social externalities.	2.54	1.24
For me, affordability is more important when deciding to buy food than paying for health externalities.	2.38	1.20
For me, affordability is more important when deciding to buy food than paying for health externalities.	2.38	1.15
For me, affordability is more important when deciding to buy food than paying for environmental externalities.	2.38	1.15
I do not think it is fair to incorporate the costs of externalities in the price.	2.42	1.34
If I have the choice, I will buy products at true price only if they become cheaper than today.	2.63	1.30
7. Green trust (trust true price characteristics)		
I trust that the true prices are calculated correctly.	3.77	1.19
I trust that the true prices are calculated correctly.	3.84	1.25
I trust that revenues will indeed be used to solve problems in the environmental and social domains.	3.66	1.35
I trust that investments will be made in agricultural companies where the food products are made so that the hidden costs will decrease there.	3.80	1.22
General food consumption/food choice motives		
8. General health interest		
The healthiness of food has little impact on my food choices. ^b	4.56	0.96
The healthiness of food has little impact on my food choices. ^b	4.41	1.43
I am very particular about the healthiness of the food I eat.	4.68	1.06
I eat what I like and I do not worry much about the healthiness of food. ^b	4.60	1.16
9. Price/quality relation		
It is important for me to know that I get quality for all my money.	4.18	0.87
I always try to get the best quality for the best price.	3.98	1.23
I compare the prices between product variants in order to get the best value for money.	3.67	1.26
I compare the prices between product variants in order to get the best value for money.	4.89	0.86
10. Price criteria		
It is important for me to know that I get quality for all my money.	3.82	1.20
I always check prices even on small items.	3.87	1.41
I notice when products I buy regularly change in price.	3.96	1.36
I look for ads in the newspaper for store specials and plan to take advantage of them when I go shopping.	3.64	1.56
11. Food involvement		
I don't think much about food each day. ^b	4.35	0.88
I don't think much about food each day. ^b	4.81	1.04
Talking about what I ate or am going to eat is something I like to do.	3.81	1.29
Talking about what I ate or am going to eat is something I like to do.	4.43	1.38
I enjoy cooking for others and myself.	4.37	1.27
I care whether or not a table is nicely set.	4.74	0.94
12. Environmental protection^a		
Has been prepared in an environmentally friendly way.	4.71	1.01
Has been prepared in an environmentally friendly way.	4.80	1.05
Is packaged in an environmentally friendly way.	4.80	1.05

(continued on next page)

Table 4 (continued)

Scales used as independent variables in the regression model	Mean	SD
Has been produced in a way which has not shaken the balance of nature.	4.72	1.00
13. Local and seasonal^a	5.06	0.87
Is a local/regional product.	5.07	0.95
Is a seasonal product.	5.12	0.89
Comes from close by (little transport distance).	4.99	1.01
14. Natural content^a	4.76	0.97
Contains no additives.	4.62	1.13
Contains natural ingredients.	5.00	0.86
Contains no artificial ingredients.	4.67	1.12
15. Familiarity^a	3.81	1.01
Is what I usually eat.	4.23	1.12
Is familiar.	4.16	1.17
Is like the food I ate when I was a child.	3.05	1.32
16. Attitude towards TCAF	4.72	1.22
not interesting - interesting	4.87	1.19
not to be applied - to be applied	4.60	1.36
not to be supported - to be supported	4.66	1.42
Negative – positive	4.75	1.36

Legend: Scales ranging from 1 - strongly disagree to 6 - strongly agree (1-strongly disagree, 2-disagree, 3-somewhat disagree, 4-somewhat agree, 5-agree and 6-strongly agree).

^a Introductory statement: "It is important to me that the food I eat on a typical day:"

^b Reversed for analyses.

3.2. Descriptive statistics

Even though consumers' previous knowledge of TCAF is limited ($M = 2.07$ on a 6-point Likert scale), after being informed, respondents showed a mean score for trust in the TCAF methodology ($M = 4.15$) (Table 4) and attitude toward TCAF ($M = 4.72$) well above the midpoint, suggesting a certain openness towards the approach.

Regarding true price-related scales, *Green trust* ($M = 3.77$) has moderate scoring (Table 4), which indicates cautious optimism among participants. Respondents showed a general trust in true pricing accuracy and perceived positively that true price has the potential to improve environmental and social predicaments. However, the moderate scoring also suggests that they have reservations.

The scale *concerns for the national economy* ($M = 3.40$) was neutrally scored (Table 4), implying that the participants may have some fears about the potential negative implications for the Swiss economy when the true price is implemented. However, they seem less afraid of the effects of true price on tourism. The *true price effect on consumption* ($M = 3.09$) (Table 4), showed neutral to negative responses from the participants, suggesting that the consumption patterns of the consumers regarding certain foods may not change exclusively based on the price changes.

Surprisingly, the low average score on the scale *affordability importance* ($M = 2.47$) (Table 4), indicates less importance to affordability and a certain willingness to pay for the externalities included in the price. The high *price-quality relation* ($M = 4.18$) suggests that consumers have careful consideration of the value of money, besides being aware of the price criteria of the products they consume ($M = 3.82$) (Table 4).

A high score of *general health interest* ($M = 4.56$), *food involvement* ($M = 4.35$) and *environmental protection* ($M = 4.74$) indicates that, on average, the respondents care about the food they eat and are more likely to prioritise food choices that are healthy and come from environmentally friendly practices (Table 4).

The finding from Table 4 also revealed high scores for *local and seasonal* ($M = 5.06$), which implies that these consumers value products produced locally. Likewise, the high interest in *natural content* ($M = 4.76$) indicates that these consumers will prioritise foods without additives or artificial ingredients. The results obtained for the scale *familiarity* ($M = 3.81$) indicate that the participants are interested in familiar foods but not necessarily the foods they used to eat as children

(Table 4).

Average results of the constructs 1–7 was also explored depending on sex, education level and diet type of the participants. Significant differences ($p < 0.05$) were revealed in regarding some constructs as displayed in Fig. 2. Females presented significantly higher scores on the "trust in TCAF" than males. In addition, respondents who declared they had a tertiary degree (University) reported on average having significantly higher "previous knowledge of externalities" than the other two groups. This group also showed lower scores on "affordability importance" compared to the ones that declared having a "mandatory - secondary" education level.

The results also revealed significant differences among the groups with different diet types, where flexitarians showed significantly higher scores on "trust in TCAF" and "green trust" compared to omnivores. Moreover, omnivores scored higher on "concerns for the national economy" and "affordability importance" than flexitarians and vegetarians/vegans ($p < 0.05$).

3.3. Regression analysis

The average obtained for attitude towards the TCAF approach was $M = 4.72$ ($SD = 1.22$). Regression analyses using attitude toward TCAF as a dependent variable revealed that four predictors had a significant impact on this outcome. 50.0 % of the variance was explained by the model (Table 5).

Trust in TCAF showed the strongest and most positive influence ($p < 0.001$) on the attitude towards TCAF. This was followed by the predictor *affordability importance* that presented a negative influence, acting as a barrier to the positive attitude towards TCAF ($p < 0.001$). Not surprisingly, *environmental protection* ($p = 0.005$) was also revealed to be a driver towards a positive attitude related to TCAF. In addition, *green trust* (related to trust in true price characteristics) also appeared as a significant predictor ($p = 0.004$) that influences positive attitudes towards TCAF.

The significance of *Trust in TCAF* indicates that the more consumers believe in the approach TCAF, its implementation and its benefits for the health and environment, the higher the positive attitude towards TCAF.

The significance of the variable *affordability importance* means that, the more consumers place a higher priority on social, health and environmental externalities mitigation over affordability of foods, the higher the positive attitude towards TCAF. *Environmental protection* also emerged as a significant predictor for positive attitude towards TCAF, where the more consumers showed interest in protecting the environment, the higher their positive attitude towards TCAF.

The presence of the predictor "green trust" in the model suggests that the more consumers trust in true price characteristics (and how the true price will support a better food system), the more positive their attitude towards TCAF.

4. Discussion

Today, there is a challenge for food systems to provide food security and nutrition to a growing population while doing so in an environmentally sustainable way. True cost accounting for food (TCAF) is a useful approach to support a transition to more sustainable food systems and healthy diets. While this tool can play a role in the future of food production and consumption, its understanding in the Swiss context is limited [14]. For this reason, this study is of great importance and can shed light on the important levers to facilitate the implementation of TCAF.

True Cost Accounting for Food (TCAF) is a new concept and to reveal determinants for a positive attitude towards TCAF, several constructs that may be related to this approach's acceptance were applied, including new constructs on true cost and true pricing. Food choice motives that reflect relevant topics for the TCAF approach such as interest in healthy and environmentally friendly foods were also explored

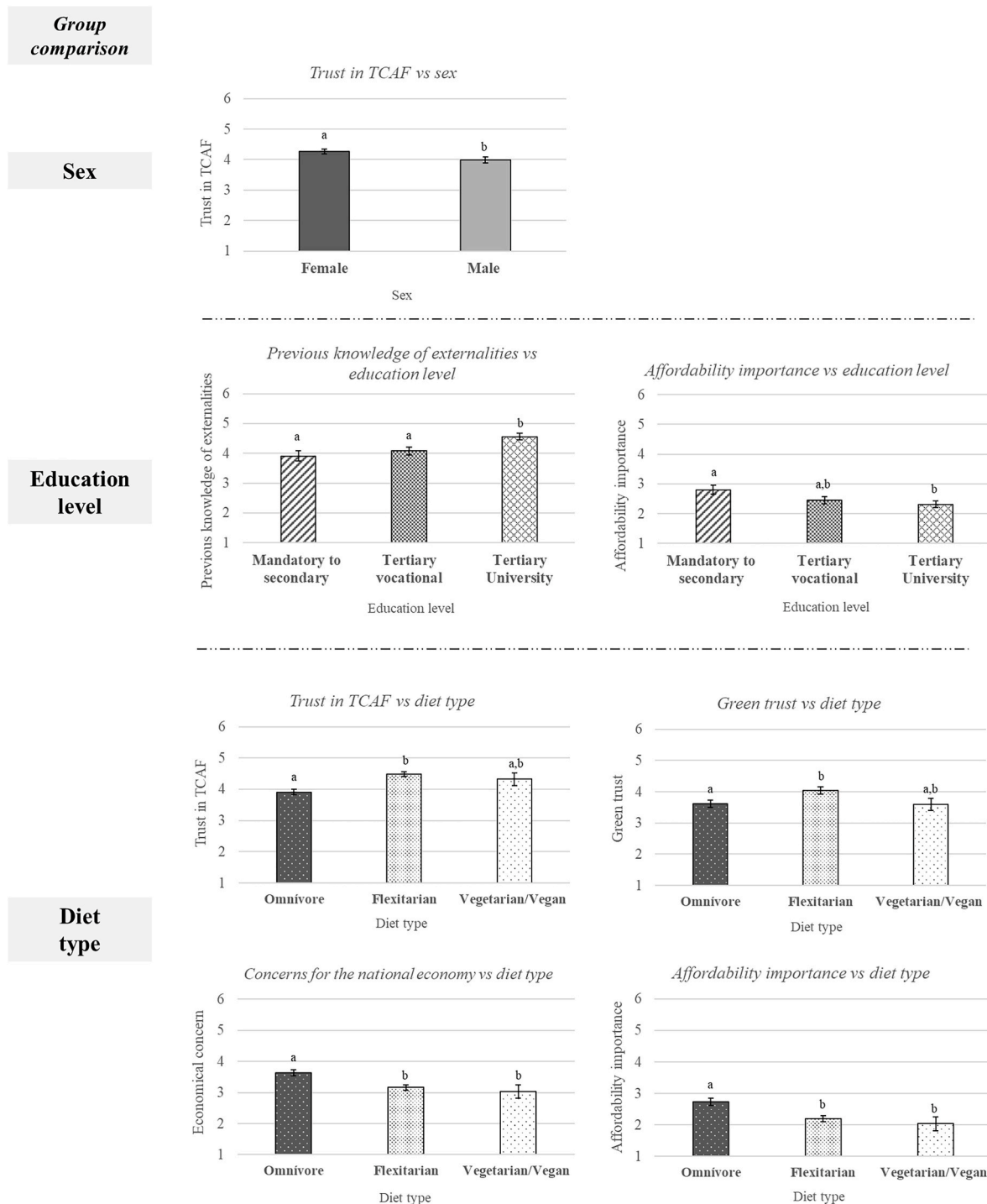


Fig. 2. Average results of constructs by group and significant differences at $p < 0.05$. Note: The graph shows only constructs related to TCAF and true price that presented significant differences at $p < 0.05$ by groups (sex, education level and diet type). Different letters in the same graph indicate significant differences ($p < 0.05$).

as factors influencing attitudes towards TCAF [2,8,12,15,27,38].

Literature reported that “Information and knowledge” is one of the individual and situational determinants for behavioural intention to sustainable food products together with other factors such as personal values, needs and motivations [39]. Descriptive statistics revealed low *previous knowledge of TCAF* (<3.5) among the respondents. Despite that, after receiving some information on the TCAF approach, a positive mean score in *trust in TCAF* ($M = 4.15$ on a 6-point Likert scale) and a positive average score for attitude towards the true cost accounting approach (M

$= 4.72$ on a 6-point Likert scale) were observed. Providing knowledge to encourage consumers to consume food more ethically and sustainably can support decision-making towards more sustainable foods [39].

In this context, promoting campaigns aiming to inform the population about the externalities involved in the current food system [15] and how we can address some of these issues by making better food choices or paying the true price of food (that can be latter converted in benefits for the food system, for example), can be effective in supporting a positive transition. Moreover, the literature suggests that creating a

Table 5

Significant predictors of the positive attitude towards true cost accounting for food ($R^2 = 0.50$).

	B	SE B	β	p	VIF
Constant	1.675	0.493		<0.001	
Trust in TCAF	0.504	0.084	0.364	<0.001	1.617
Affordability importance	-0.270	0.062	-0.243	<0.001	1.362
Environmental protection	0.212	0.074	0.164	0.005	1.430
Green trust	0.163	0.056	0.159	0.004	1.309

Legend: B= Unstandardized B; SE B= Coefficients standard error; β = Standardized coefficients beta; p = significance; VIF = variance inflation factor. Dependent variable: attitude towards TCAF. N = 224.

discipline on the topic to educate not only the stakeholders involved in the food system but the whole population besides integrating the true cost in product labelling can also be effective [5,14] and may support consumers to make climate-friendly decisions when buying food [40].

The findings of the present research also highlighted the trust/openness of Swiss residents towards the true price (Table 4, constructs 4–7) after being informed. The average obtained for the scale green trust revealed some positive behaviour (but cautious) towards the payment of externalities by the consumers. In addition participants presented low average scores (<3.5 on a 6-point Likert scale) on the scales “true price effect on consumption” and “affordability importance,” meaning that, in general, consumers reported that the price changes are not likely to exert effects on their current food consumption and that paying for externalities is more important than the affordability of foods, respectively. However, these findings should not be generalised as the socioeconomic status and the educational level of the evaluated sample may have contributed to these results. In the present study, a large part of the sample had a high income and high educational level (Table 1). Moreover, the results should be interpreted with caution, as an intention-behaviour gap can occur.

The openness of the participants towards the methodology did not come as a surprise in a sample with high interest in general health, in the natural content of the foods, local and seasonal foods and in protecting the environment (Table 4). Recent research using a larger sample size of Swiss residents also has found Swiss consumers with similar characteristics regarding general health interest and interest in local and seasonal foods, confirming the interest of Swiss consumers in these practices [19, 20].

Regarding the comparison between different groups, the results revealed that females and flexitarians are more prone to trust in TCAF than males and omnivores, respectively. In the same way, Lucas et al. [20] revealed that the segment in Switzerland more willing to accept microalgae as a sustainable and alternative protein was mostly composed of females and non-omnivores. Aweke [41] revealed a relationship between females and consumers with high education levels and a higher willingness to pay a premium price for organic meat. Thus, we suggest that future studies on TCAF implementation should consider these groups for further investigation, as they seem to be more open to sustainable practices. Besides trust in TCAF, flexitarians also showed significantly higher scores in “green trust (related to true pricing)” than omnivores and significantly lower scores for “concerns for the national economy” “affordability importance” than conventional meat eaters. This highlights that this group may be more open to accepting TCAF and true pricing approaches.

The regression analysis was conducted to reveal the determinants for a positive attitude towards the true cost accounting for food approach. From the variables evaluated, four emerged as significant. The construct “trust in TCAF” was found as the strongest driver to a positive attitude towards TCAF, and it was related to the belief of consumers in the approach as well as in the correct implementation of this tool. In the same way, the significance of the predictor “green trust (trust true price characteristics)” reveals that improving consumers’ trust in the true pricing approach is directly related to a more positive attitude towards

TCAF. In the same way, Taufik et al. [8] reported the level of trust as a mediator for the purchase intention of true-price food by Dutch consumers. Thus, building trust can be considered one of the strategies to promote the acceptance of true price food.

The significance of the construct of “affordability importance” highlighted that the willingness of Swiss residents to pay for the externalities involved in the food system was a driver of the positive attitude towards TCAF. In the same way, a true-price experiment with coffee in the Netherlands revealed some consumers willing to pay for external social and environmental costs [17]. Next, “environmental protection”, a construct related to ethical food choice motives that measures the interest of consumers in consuming foods environmentally friendly, was considered a driver to a positive attitude towards TCAF. Previous research demonstrated that consumers’ concern about the environment can have a positive impact on purchasing behaviour [23,25]. Therefore, campaigns focused on the environmentally friendly aspects of the TCAF implementation and true-price foods may support the acceptance of a true-cost approach by Swiss residents.

Despite being at the initial stages, the true cost accounting for food is a promising tool to support food system improvement. The implementation of this approach is complex and will require support from all actors involved in the food system (e.g.: producers, government, consumers) [11]. This study sheds light on the unexplored perceptions of Swiss residents towards true cost and true pricing, and based on the findings, we can assume that there is room for the implementation of these tools in the Swiss context.

4.1. Limitations

The present exploratory study has limitations. Only a limited portion of the Swiss population was evaluated; they were German-speaking residents, and they showed a high education level and relatively high income. Therefore, the findings cannot be generalised to the whole Swiss population. For the next studies, we suggest targeting a larger sample size, including French and Italian-speaking Swiss residents, representative of Swiss consumers. We also suggest segmenting this population [42] regarding its attitudes and perceptions towards TCAF. Second, a difference in reported and actual attitudes among the consumers can occur (intention-behaviour gap). Thus, we suggest that future studies explore these differences by applying other methodologies such as conjoint analyses or by assessing consumers’ behaviour in a real-life scenario. By using this approach, we would be able, for example, to translate the notion of how much more consumers are willing to pay for different food models (e.g., processed food, animal-based food, vegetables, organic food options) that account for health, environmental and social costs. Finally, further studies could analyse other implementation avenues such as information-based (e.g. labels, education) measures or other market-based instruments (e.g. tax and subsidy system).

5. Conclusions

True cost accounting for food (TCAF) can contribute to food systems transformation towards healthier and more sustainable diets, consequently to the achievement of the UN Sustainable Development Goals. This study investigated the attitude and perception of Swiss residents towards the true cost and true price of food. The descriptive results revealed that the participants lacked previous knowledge about TCAF, however, after receiving information about the approach, they showed positive and somewhat high scores for a positive attitude toward TCAF and trust. When comparing groups with different characteristics, females and flexitarians seem to be more prone to trust TCAF than males and omnivores, respectively. In general, the participants also reported that paying for externalities in the price of food is more important than affordability aspects.

The regression results revealed that trust in TCAF, affordability importance, environmental protection and green trust (trust in true

price) are significant predictors of a positive attitude towards TCAF. Trust in the capacity of the true cost and true pricing to contribute to uncovering and solving issues related to the externalities was a strong driver of TCAF's positive attitude. Whereas the less the respondents showed concern about the affordability of food, the higher the positive attitude towards TCAF. The interest of consumers in protecting the environment also predicts a positive attitude towards TCAF. These findings can be used to set strategies to target groups and support communication strategies to increase consumer knowledge. This investigation can be useful to stakeholders along the food chain, marketers, policymakers and food handlers and contribute to the successful implementation of the TCAF methodology.

CRedit authorship contribution statement

Barbara Franco Lucas: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Farwa Abbas:** Writing – original draft, Investigation, Formal analysis, Data curation. **Kate Dassel:** Writing – review & editing, Visualization, Validation, Methodology. **Joachim Marti:** Writing – review & editing, Visualization, Validation, Resources, Methodology, Funding acquisition. **Thomas A. Brunner:** Writing – review & editing, Visualization, Validation, Supervision, Resources, Project administration, Methodology, Funding acquisition, Data curation, Conceptualization.

Ethical statement

The guidelines of Ethical Conduct in Research from the Bern University of Applied Sciences were followed when designing the survey, conducting the study, and analysing the data.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data and questionnaire can be found at: <https://doi.org/10.34914/olos:lat55welpvcqdfun6nzi3bqalu>.

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