# GOOD FOOD PRINT – THE CONCEPT OF AN IT SYSTEM TRACKING THE LEVEL OF GOOD PRACTICES USED IN ORGANIC FOOD PRODUCTION PROCESS AND IN ITS SUPPLY CHAIN

Tomasz Woźniakowski✉

Warsaw University of Life Sciences – SGGW

## ABSTRACT

The aim of the paper is to present and pre-test the method being a modification of the composite measure based on calculating the weighted average value of features corresponding to the degree of various good practices in organic farming. The value calculated by the proposed method is a postulated basis for the operation of an IT system which would enable consumers to follow the production, certification and supply chain processes related to organic food products. The system also allows the manufacturers to choose good sub-suppliers more easily and incline them to achieve perfection at every stage of production. In the paper, the function constituting the main element of the system's algorithm was tested and modified, and the other postulated functions were described.

**Key words:** quality, transparency, supply chain, aggregate measures, Internet of things, IT system, registers

## INTRODUCTION

According to the definition taken from the law of the European Union [Council Regulation (EC) No 834/2007], organic production "is an overall system of farm management and food production that combines best environmental practices (…) and a production method in line with the preference of certain consumers for products produced using natural substances and processes". Thus, in the basic legal act, in addition to the obligation to meet environmental standards and the use of best practices, it is emphasized that organic farming is a response to the specific demand of conscious consumers. The trust seems to be very important, for the producers and the whole supply chain. Customers want to be certain that the food product is actually produced at the best known practices, minimising the negative impacts of the polluted environment and chemical additives that in the long term can have an extremely destructive impact on the health of consumers [Hamzaoui-Essoussi and Zahaf 2012]. The building of trust is provided by a legally established certification system, which monitors producers on a regular basis in the form of periodical inspections ensuring that all activities are compliant with the standards. However, building the next stages of the information society [Bell 1973], we face a new type of customer, often referred to "customer 2.0", which has a number of new features [Gaudin 2011]. It is characterized by a great need to collect comprehensive information about the product, the ability to perform comparisons of product offers, viewing rankings and ratings and a need to use information and mobile tools for this purpose. Another important phenomenon is the constant increase in the scale of organic food production in Poland (Fig. 1) and the European Union. Many producers see their chance
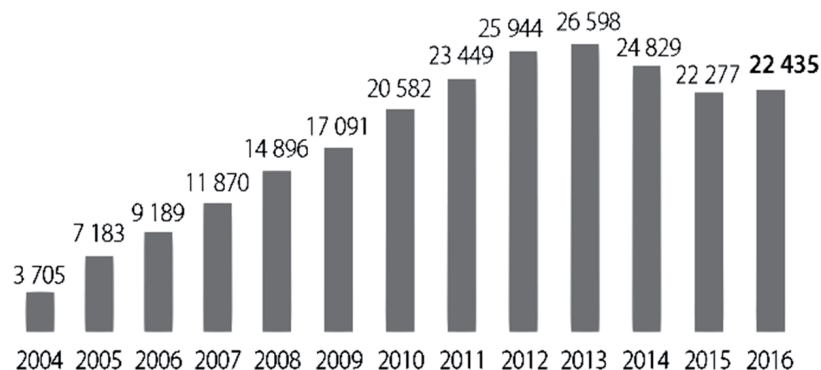
✉ tomasz_wozniakowski@sggw.pl

**Fig. 1.** Number of bio-food producers in Poland in years 2004–2016

Source: Zdrojewska [2017].

in being "eco". The number of agricultural entities conducting organic production in Poland has grown several times over the last several years [Zdrojewska 2017].

At the same time, the development in the following years clearly fluctuates due to the specificity of this production (e.g. the need for crop rotation, avoidance of chemical substances), problems with environmental pollution and supply chain, which makes the production process difficult to maintain for some entities. In addition, according to press reports, from time to time we are witnessing scandals related to abuses within the extended supply chains in the process of organic food production, most often involving into the production cycle ingredients, that do not meet standards despite having the appropriate certificate [Kelly 2017]. In connection with the above-mentioned phenomena, it is postulated to create an IT tool enabling consumers to assess the quality of a particular product based on the degree of good practices measure for the production process by the manufacturer and its suppliers. The Good Food Print system would be a mobile application that would disclose information for a selected product and also calculate a point score (meter) showing the manufacturer's and supplier's propensity to provide information related to the production and delivery process. The main purpose of this study is to present a method that is a modification of the composite measure. It includes calculating the weighted average value of features corresponding to the degree of various good practices application for organic farm-

ing. The initial testing of the method behaviour after the introduction of sample data is also described. Also the overall method of the system operation will be presented and described.

## RESEARCH METHOD

The essence of system operation is the method being a modification and the specific application of composite measure. The weighted average values of certain characteristics are calculated. They answer the question: to what extent, in the given production element throughout the supply chain, various good practices related to organic food were applied. The main assumption is to provide customers with a transparent and honest system, supplementary to the quality validation certificates and compliance with the best practices of organic production. On the other hand, it enables us to provide manufacturers with a tool that makes it easier to choose good sub-suppliers and to encourage them to achieve perfection at every stage of production. The natural, expected feature of the system will be the promotion of growth of all "eco market" entities, which are characterized by reliability, honesty and transparency. These values will allow consumers to increase trust in entities and products, make optimal choices and promote their best purchasing decisions. The added value for producers (in the case of implementing the system as an IT tool) will be functionalities allowing to keep registers required by the certification rules, necessary for proper management and external control of production

processes. In the course of the direct interview with employees of the Agro-Bio-Test certification body, it was established that currently there are no dedicated solutions to keep such obligatory registers and the producers use Excel or keep them on sheets of paper by hand. The registers will also be a source of data for the system, ensuring its proper reliability and completeness. The system, thanks to the algorithm used, remains extremely open and egalitarian. According to the spirit of ecological production, it does not promote large-scale production in any way. On the contrary, it seems that the best results can be achieved by producers who prefer quality over production volume. In addition, the postulated system will complementary to the system of certificates by deriving the value of the indicator for a specific product, not as in the case of certificates, for the producer.

The indicator (meter) is most often understood as a number expressing the level of a given phenomenon. The most important feature of the indicator is the comparability of its value, allowing to determine the position of a given object compared to other objects [Rogala and Rycharski 2006]. In this case, it will be the product's position against the others as a function of production and supply chain characteristics. It is therefore a function of several features, also called diagnostic variables. There is a multiplicity of attributes (many different features of organic production) so we can define the meter as synthetic, aggregate or composite. The postulated and described features affecting the index can be included in the set of stimulants, the higher value of which indicates a higher level of the phenomenon (object) and thus works in a way that stimulates development [Kompa 2009]. The selection of diagnostic variables and determination of their impact on the object was carried out as follows: the set of products was limited to the area of crop production. Two most important features have been distinguished for the area: fertilization and plant protection. They were established on the basis of the analysis of procedures during the interview with employees of the Agro-Bio-Test certification body.

On the basis of the proposed contractual measure with three levels: 10, 40 and 100, the possible values of qualitative features were defined. The use of the same scale for different features solves the problem of

normalization, that is, reducing them to comparability [Zeliaś 2000]. In the future, if it is necessary to apply a greater number of quality features, it is proposed to create a geometrical sequence determining the next values of the feature. The use of a geometric sequence will provide the appropriate motivation to improve production parameters and achieve a clear increase in the score. If the function is used for other types of production, it is also allowed to use other values of features to which the postulated quality scale will not apply. The normalization problem should in this case be solved by the formula dividing the feature value by the base value. In the case of a stimulant, the base value would be considered as assumed maximum value and for the destimulator, minimum value. The index value is based on the following formula:

$$Gfp = \frac{\sum_{i=1}^{k}\left(a_i \frac{V_i}{Vb_i}\right)}{k} \cdot \frac{\sum_{i=1}^{l} Gfp(d)_i}{\sum_{i=1}^{l} Gfp(d)_i + Z \cdot l^2}, \quad l > 0 \qquad (1)$$

and

$$Gfp = \frac{\sum_{i=1}^{k}\left(a_i \frac{V_i}{Vb_i}\right)}{k}, \quad l = 0 \qquad (2)$$

where: $Gfp$ – Good Food Print indicator adopting values from the minimum value (greater than zero) to one. The indicator determines the degree of good practices application in the production process and in the supply chain for a specific organic product at a specific producer;

$a_i$ – weight of the the $i$-feature (value range $0 – 1$);

$V_i$ – the value of the $i$-feature;

$Vb_i$ – reference value (maximum) of the $i$-feature;

$k$ – number of features;

$Gfp(d)_i$ – value of $i$-$Gfp$ index for $i$-supplier product;

$Z$ – "damping" factor;

$l$ – number of suppliers.

For $l > 0$ the presented pattern can be compared to the asymptotic function of Törnquist I:

$$Y \frac{aX}{X+\beta}, \quad \alpha, \beta > 0 \tag{3}$$

where:

$$\alpha = \frac{\sum_{i=1}^{k}\left(a_i \frac{V_i}{Vb_i}\right)}{k} \tag{4}$$

$$\beta = Z \cdot l^2 \tag{5}$$

$$Y = Gfp \tag{6}$$

$$X = \sum_{i=1}^{l} Gfp(d)_i \tag{7}$$

It means that, the value of $Gfp$ for $l > 0$ tends asymptotically to $Gfp$ for $l = 0$ (no suppliers) depending on the value of $X$, i.e. the sum of $Gfp$ indicators of the products of these suppliers. The speed of pursuit of the $\alpha$ value will be regulated by the number of suppliers (the more, the slower with geometric progression). The presented method is also based on the values of $Vi$ features measured by the IT system based on collected data from the set established for a given type of food production. It is postulated to introduce values for individual qualitative features, which add up to one hundred in the manner justified above in this study.

**TESTING OF THE MODEL**

For crop cultivation characteristic $V_{(n)}$ "fertilization" – the first level takes the value of 10 and it is obtained for disclosing the certificate number and declaring the keeping of fertilization register (RNU) which is mandatory in the light of the certification rules. The second level and another 30 points are obtained when the producer keeps the RNU (Fig. 2) in the proposed

IT system and the content of entries regarding treatments on the crop is disclosed to the public.

The third level and a further 60 points are given to the farm for additional disclosure of the type of fertilizer used, and confirmation by the system that all fertilization operations are carried out using authorized means for organic farming in accordance with the approval set provided by the Crop Fertilization Institute and Soil Science in Puławy (IUNG-PIB). The system confirms this compliance automatically on the basis of the data from the RNU register, and the certification body in addition through soil testing. The third level is also achieved when all fertilization activities are declared as fertilization with own resources. The value of the $V_{(n)}$ feature is therefore 100 when reaching the third level and 40 while the second level, for first it is 10.

In a similar way, the postulated system will verify the value of further features for a given type of crop. For simplicity, let us assume that this is just one more feature of $V_{(o)}$ – plant protection. Let us conduct a simple simulation. We will add the values of features and suppliers' products $Gfp$ for hypothetical production. To simplify, the weight of the features we will assume as one and the $Z$-factor will be set at 0.01. The determination of this coefficient will ultimately depend on the conducted research including mass data from farms, thanks to which the optimum value most accurately reflecting the reality will be determined. The simulation used some of the data recorded by Agro-Bio-Test.

Other data entered into the formula: $V_1 = 40$; $V_2 = 10$, which means the first level for the second feature and second for the first one. Next: $Vb_i = 100$; $k = 2$; $Gfp(d)_1 = 0.1$; $Gfp(d)_2 = 0.25$ and $L = 2$. We have two suppliers with relatively low $Gfp$:

$$Gfp = \frac{\frac{40}{100}+\frac{10}{100}}{2} \cdot \frac{0.1+0.25}{0.1+0.25+0.01 \cdot 2^2} \tag{8}$$

So: $\alpha = 0.25$; $\beta = 0.04$; $x = 0.35$ and $y = Gfp = 0.22$.

| Date | Parcel | Area (ha) | Plant | Type of fertilizer | Amount of fert. | Own / purchased | Supplier / remarks |
|------|--------|-----------|-------|--------------------|-----------------|-----------------|--------------------|
| \<date\> | \<parcel\> | \<area\> | \<plant\> | \<fertilizer\> | \<am\> | \<own-pur\> | \<supp\> |

**Fig. 2.** Example RNU register

Source: Own preparation based on www.agrobiotest.pl

We will now change the quality of suppliers with constant remaining parameters (Table 1), for one supplier (Table 2) and for three suppliers (Table 3).

**Table 1.** Suppliers quality changes

| Parameter | Two suppliers of lower quality than the producer | Two suppliers of the same quality as the producer | Two suppliers of the highest quality |
|---|---|---|---|
| $\alpha$ | 0.25 | 0.25 | 0.25 |
| $\beta$ | 0.04 | 0.04 | 0.04 |
| $x$ | 0.35 | 0.50 | 2.00 |
| $y$ | 0.224 | 0.231 | 0.245 |

Source: Own preparation for one supplier.

**Table 2.** Supplier quality changes

| Parameter | Supplier of lower quality than the producer | Supplier of the same quality as the producer | Supplier of the highest quality |
|---|---|---|---|
| $\alpha$ | 0.25 | 0.25 | 0.25 |
| $\beta$ | 0.01 | 0.01 | 0.01 |
| $x$ | 0.10 | 0.25 | 1.00 |
| $y$ | 0.227 | 0.240 | 0.247 |

Source: Own preparation and for three suppliers.

**Table 3.** Three suppliers quality changes

| Parameter | Three suppliers of lower quality than the producer | Three suppliers of the same quality as the producer | Three suppliers of the highest quality |
|---|---|---|---|
| $\alpha$ | 0.25 | 0.25 | 0.25 |
| $\beta$ | 0.09 | 0.09 | 0.09 |
| $x$ | 0.45 | 0.75 | 3.00 |
| $y$ | 0.208 | 0.223 | 0.242 |

Source: Own preparation.

In our case, the value of *Gfp* tends asymptotically to $\alpha$, which means that the producer with sub-suppliers will never reach the value of the *Gfp* index for the zero number of suppliers:

$$Gfp = \frac{\sum_{i=1}^{k}\left(a_i \frac{V_i}{Vb_i}\right)}{k} \quad (9)$$

We also see that the increasing number of suppliers reduces the "pursuit" speed of the asymptote. The assumption that sub-suppliers "pull" *Gfp* down, especially when there are more of them, and when themselves have lower indexes seems to be right (Fig. 3). The more suppliers and the lower their quality, the greater chance is that a product of organic farming will not be good enough [Hamzaoui-Essoussi and Zahaf 2012]. However, lowering *Gfp* also for one supplier with the same or higher *Gfp* seems to be a formula behaviour that does not fully reflect the reality. For such a situation, the distance of the *Gfp* value from the value of *Gfp* for no suppliers is about 0.01. If, therefore, we increase $\alpha$ by this amount, while ensuring that it never exceeds one:

$$Gfp = \left\{\frac{\sum_{i=1}^{k}\left(a_i \frac{V_i}{Vb_i}\right)}{k} + \left(\frac{1-\alpha}{100}\right)\right\} \cdot \frac{\sum_{i=1}^{l} Gfp(d)_i}{\sum_{i=1}^{l} Gfp(d)_i + Z \cdot l^2} \quad (10)$$

$$Gfp = \left\{ \frac{\sum_{i=1}^{k}\left(a_i \frac{V_i}{Vb_i}\right)}{k} + \left(\frac{k - \sum_{i=1}^{k}\left(a_i \frac{V_i}{Vb_i}\right)}{100k}\right)\right\} \cdot \frac{\sum_{i=1}^{l} Gfp(d)_i}{\sum_{i=1}^{l} Gfp(d)_i + Z \cdot l^2} \qquad Gfp = \frac{99\sum_{i=1}^{k}\left(a_i \frac{V_i}{Vb_i}\right) + k}{100k} \cdot \frac{\sum_{i=1}^{l} Gfp(d)_i}{\sum_{i=1}^{l} Gfp(d)_i + Z \cdot l^2}$$

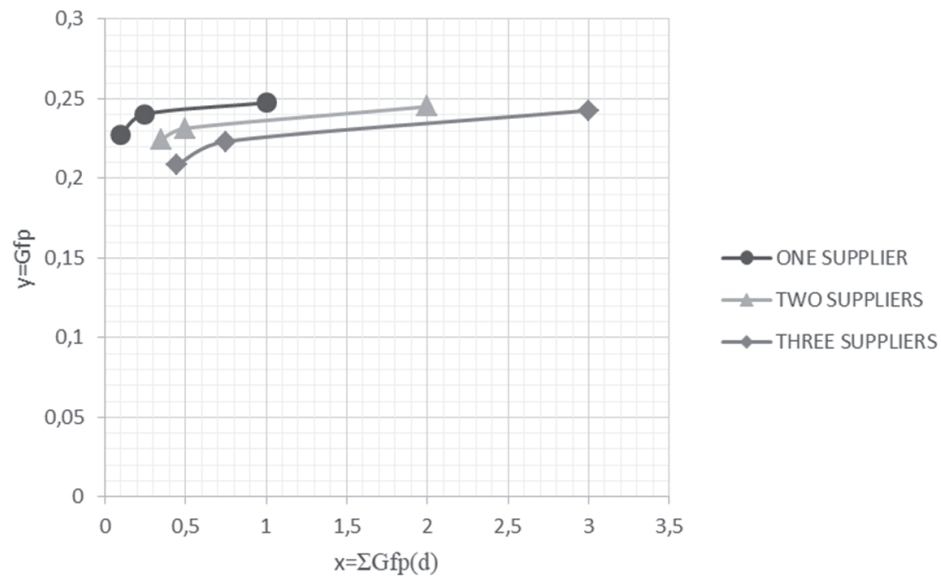$$(11) \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad (12)$$



**Fig. 3.** Changes in the *Gfp* index for a different number of suppliers
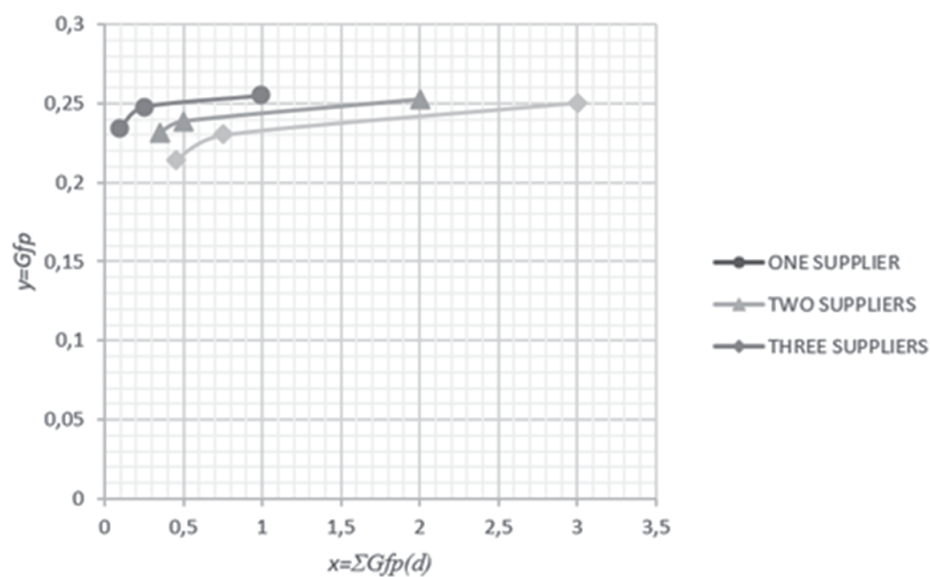
Source: Own preparation.



**Fig. 4.** Changes in the *Gfp* index for a different number of suppliers for changed function

Source: Own preparation.

With such a redesigned formula, we see that the *Gfp* value equation with the *Gfp* value for no suppliers, becomes the case for a single supplier with the same quality factor. For two or three, such a situation is possible only if their quality is the highest (Fig. 4).

## OTHER FUNCTIONS OF THE SYSTEM

Technically, the system will use an online database and a mobile application. Scanning the bar code or QR code of the selected organic farming product will allow viewing certificates related to the product. It also would show the whole tree of suppliers, review their certificates and, above all, get the value calculated in accordance with the previously presented method, the *Gfp* index expressed in numerical or graphic form, e.g. stars.

The use of such a system by the consumer will also enable operation in so-called Internet of Things (IoT) formula. Scanning a product in a store associated with location data of a mobile device can create hints for consumers in which stores specific products can be found. It seems to be particularly important in short and dispersed series of products offered in various locations, which is common for organic production. The system also encourages producers to enter data into the system because the more transparent they will be, the more attractive they would appear for the whole chain of production, thanks to accumulative property of *Gfp* index. In addition, the registers within the system are mandatory for certification purposes. It is important to provide the records as easy to use solution for the producer. This feature of the postulated system also seems to be a response to problems related to digital exclusion in rural areas [Śmiałowski et al. 2015].

## CONCLUSION

In first stage of the research, the function determining the *Gfp* index was pre-tested and modified. The overall concept of the system seems to be ready for further research and trial implementations. It is postulated in further stages, to simulate the operation of the proposed method on the extended database of farms. It will be necessary to make the final "regulation" so that it behaves in a desirable and fair manner, embracing various modes of approach to organic production. The possibility of using artificial intelligence in place of the "rigid" formula should also be taken into account. The use of machine learning using the induction method, e.g. LEM supplemented by other methods such as regression models would potentially give the effect of greater flexibility in non-standard situations. The next postulated action will be the production of the solution's prototype. It should be noted that there is a considerable potential for extending the system, e.g. information on acting in accordance with Fair Trade certificates and others.

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## GOOD FOOD PRINT – KONCEPCJA SYSTEMU INFORMATYCZNEGO ŚLEDZĄCEGO POZIOM WYKORZYSTANIA DOBRYCH PRAKTYK W PROCESIE PRODUKCYJNYM ORAZ W ŁAŃCUCHU DOSTAW ŻYWNOŚCI EKOLOGICZNEJ

### STRESZCZENIE

Celem artykułu jest przedstawienie i wstępne przetestowanie metody będącej modyfikacją miary agregatowej polegającej na wyliczaniu średniej ważonej wartości cech odpowiadających stopniu zastosowania różnorakich, dobrych praktyk rolnictwa ekologicznego. Wartość wyliczonego proponowaną metodą miernika jest postulowaną podstawą działania systemu informatycznego służącego konsumentom do śledzenia procesu produkcyjnego, certyfikacyjnego oraz łańcucha dostaw związanego z produktami żywności ekologicznej. System pozwala także producentom łatwiej dobierać dobrych poddostawców oraz skłania ich do osiągania perfekcji na każdym etapie produkcji. W pracy przetestowano i zmodyfikowano funkcję stanowiącą główny element algorytmu systemu oraz opisano pozostałe postulowane jego funkcje.

**Słowa kluczowe:** jakość, transparentność, łańcuch dostaw, miary agregatowe, Internet rzeczy, system informatyczny, rejestry