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# ASSESSING THE STRATEGIC FACTORS AND CHOOSING THE DEVELOPMENT SCENARIOS FOR LOCAL ADMINISTRATIVE UNITS USING AHP

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**Abstract**

The main aim of this study is to assess the strategic factors (objectives, tasks and development scenarios) and to select the best scenario for local administrative units. Two approaches are used to solve this problem: classical and fuzzy analytic hierarchy process based on experts' opinions. The research was based on data from surveys with the councillors of the urban and rural municipality of Międzychód and the rural municipality of Chrzypsko Wielkie. The importance of strategic factors for both municipalities was assessed, and the best development scenario was selected. As shown by the research, the most important scenario for the municipality of Chrzypsko Wielkie involves the development through support for entrepreneurship and agri-food processing, while that for the municipality of Międzychód involves the development by supporting housing, services and tourism.

**Keywords:** strategic factors, choice of scenario, AHP, FAHP.

## 1 Introduction

Local development planning involves solving many complex decision-making issues based on multiple criteria. One of them is to establish a development strategy which includes assessing the strategic factors (objectives, tasks and development scenarios) and choosing the best scenario. As the local development planning implies complex problems which require multidisciplinary know-how, it is helpful to rely on experts' opinions and on multiple-criteria decision-making

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methods. Many various multiple-criteria decision-making methods exist, including the following groups: additive methods, analytic hierarchy and related methods, verbal methods, ELECTRE, PROMETHEE, reference point methods and interactive methods (see Trzaskalik, 2014a; 2014b). Each of these support methods features specific advantages, disadvantages and limitations. Therefore, it is important to select the right method for a specific decision-making problem. As regards local development planning, the problem is to assess the strategic factors and select the best development scenario among a finite number of options. This process consists in establishing the hierarchy of strategic factors, and ultimately results in selecting the best scenario. Thus, the decision makers are able to identify the most important strategic factors which, based on available information and preferences, may be regarded as the most appropriate ones and be recommended for use in local development planning. When solving such a problem, it is useful to employ the analytic hierarchy methods, including the classic (Saaty, 1980) and the fuzzy (Chang, 1996) analytic hierarchy process.

The aim of this study is to assess the importance of objectives, tasks and development scenarios, and to select the best scenario for local administrative units. To solve this problem, the assessment of strategic factors was underpinned by two approaches: the classic and the fuzzy analytic hierarchy process, which were based on opinions from municipal councillors. The surveys were conducted among the councillors of the Międzychód urban and rural municipality and of the Chrzypsko Wielkie rural municipality (Śmigielska, 2013).

## 2 Research methodology

The following steps are identified in the process of assessing the strategic factors and selecting the development scenario based on the classic (AHP) and fuzzy analytic hierarchy process (FAHP):

Step 1. Building the hierarchic diagram of strategic factors impacting the development of a local administrative unit.

Step 2. Pairwise comparisons of relevance between strategic factors.

Step 3. Validating the comparisons made by experts.

Step 4. Calculating the local and global priorities of strategic factors. Selecting the best development scenario.

The first step consists of building the hierarchic decision-making diagram which includes the key strategic factors impacting the development of a local administrative unit (Figure 1).

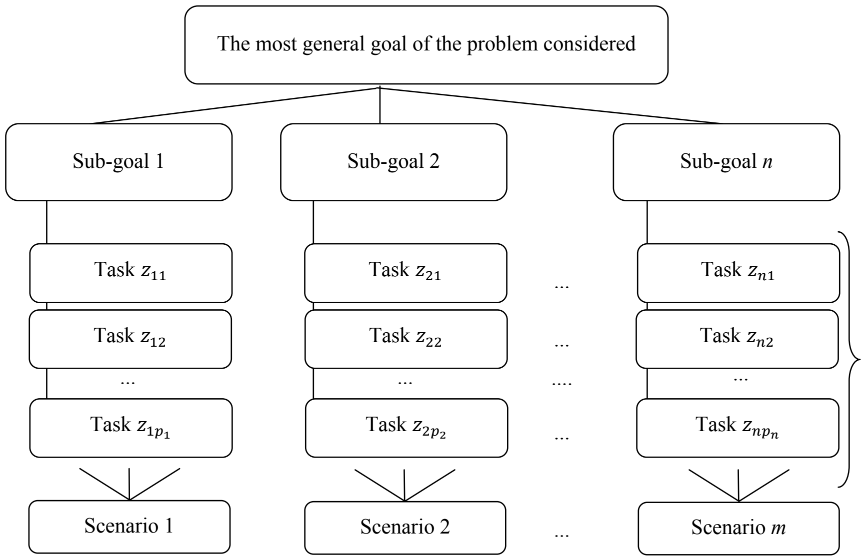


Figure 1. Hierarchic diagram of strategic factors for a local administrative unit

Source: Author's own study based on Saaty (1980).

Table 1: Nine-grade scale of preferences between two strategic factors

| **Intensity of importance** | **Verbal description (assessment) of preferences** | **Intensity of importance, numerical assessment** | |
|---|---|---|---|
| | | **AHP** | **FAHP** |
| Equal importance | Both factors contribute equally to achieve the objective | 1 | $\tilde{1}$ = (1, 1, 1) |
| Weak | Slight preference of one strategic factor over another (the first strategic factor is slightly more important than the other) | 3 | $\tilde{3}$ = (1, 3, 5) |
| Strong | Strong preference of one strategic factor over another (the first strategic factor is significantly more important than the other) | 5 | $\tilde{5}$ = (3, 5, 7) |
| Very strong | Very strong preference of one strategic factor over another (the first strategic factor is definitely more important than the other) | 7 | $\tilde{7}$ = (5, 7, 9) |
| Absolute | Absolute preference of one strategic factor over another (the first strategic factor is absolutely more important than the other) | 9 | $\tilde{9}$ = (7, 9, 9) |
| Compromise comparisons between the above values | If the decision maker is unable to choose between two neighboring ratings, intermediate values are used | 2, 4, 6 and 8 | $\tilde{2}$ = (1, 2,4); $\tilde{4}$ = (2, 4, 6); $\tilde{6}$ = (4, 6, 8); $\tilde{8}$ = (6, 8, 9) |
| Transitiveness of grades | If strategic factor $i$ has one of the above grades assigned to it when compared with strategic factor $j$, then $j$ has the reciprocal value when compared with $i$ | reciprocals of above | reciprocals of above |

Source: Saaty (1980); Wang et al. (2009).

The main strategic goal is placed at the top of the hierarchy (level I), and is broken up into sub-goals (level II). Each sub-goal includes separate packages of strategic tasks (level III) which affect the achievement of sub-goals. The tasks may also be decomposed into sub-tasks. The lowest level consists of the alternative decisions (development scenarios). The number of hierarchy levels depends on the intended level of detail (or generalization) to be maintained in the study, but it should not exceed seven[1]. Also, there should be no more than nine[2] sub-goals, tasks within a sub-goal or development scenarios.

In the second step, strategic factors are assessed by experts through pairwise comparisons of importance at each level of hierarchy. At level II, sub-goals are compared by their contribution (importance) to the main goal. At level III, the importance of strategic tasks which contribute to the sub-goals is compared. The lowest level consists in the pairwise comparison of development scenarios based on their impact on the implementation of specific strategic tasks. The nine-grade scale of preferences between two strategic factors is used in the comparisons (Table 1). Verbal descriptions of preferences are converted into real numbers in AHP, or into triangular fuzzy numbers in FAHP. The results are written down in the pairwise comparison matrix:

$$\mathbf{A} = \begin{bmatrix} 1 & x_{12} & \dots & x_{1(\bullet)} \\ \frac{1}{x_{12}} & 1 & \dots & x_{2(\bullet)} \\ \vdots & \vdots & \dots & \vdots \\ \frac{1}{x_{1(\bullet)}} & \frac{1}{x_{2(\bullet)}} & \dots & 1 \end{bmatrix},$$

where (•) stands for: $n$ (the number of sub-goals), $p_k$ (the number of tasks for $k$-th goal, $k = 1, 2, \dots, n$), $m$ (the number of scenarios); $x_{ij}$ is the intensity of importance of strategic factor $i$ over strategic factor $j$ in AHP ($i, j = 1, \dots, (\bullet)$); these are average values[3] of pairwise comparison assessments made by experts. Moreover, we have: $x_{ij} = 1/x_{ji}$ (transitiveness of grades) and $x_{ii} = 1$ (equivalence of grades). In the case of FAHP, $x_{ij}$ ($i, j = 1, \dots, (\bullet)$) are replaced by triangular fuzzy numbers $\widetilde{x}_{ij} = (l_{ij}, m_{ij}, u_{ij})$, where $\widetilde{x}_{ij} = 1/\widetilde{x}_{ji} = (1/u_{ji}, 1/m_{ji}, 1/l_{ji})$ and $\widetilde{x}_{ii} = (1, 1, 1)$.

In the third step, the pairwise comparisons are validated (see also Alonso and Lamata, 2006). For that purpose, the inconsistency ratio $CR$ (Saaty, 1980) can be used:

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1 This is because of the limitations of short-term memory (Miller, 1956).

2 This is because of the limited ability to memorize information: a human can compare a maximum of five to nine items without making any significant errors, depending on the type of information compared (Miller, 1956).

3 The geometric mean or median can be used to average the experts' assessments.

$$CR = CI / RI \cdot 100\%,$$

where $CI = \frac{\lambda_{\max} - n}{n-1}$ is the inconsistency index; $\lambda_{\max}$ − the maximum or main eigenvalue of the comparison matrix **A**; $n$ − the number of rows (columns) in matrix **A**; $RI$ − the average random inconsistency index calculated based on a randomly generated $n \times n$ matrix[4] (Table 2).

Table 2: Average random inconsistency index

| **Matrix rank** | *n* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Inconsistency index** | *RI* | 0.0000 | 0.0000 | 0.5245 | 0.8815 | 1.1086 | 1.2479 | 1.3417 | 1.4056 | 1.4499 |

Source: Alonso and Lamata (2006).

The inconsistency ratio *CR* should not exceed 10%. Otherwise, the information on preferences obtained from the experts needs to be verified as it suggests an excessive incoherence of pairwise comparisons between strategic factors. In that case, it is recommended to repeat the pairwise comparisons (Saaty, 1980).

As regards FAHP, if the pairwise comparisons are consistent in matrix **A** composed of elements $m_{ij}$, then the pairwise comparisons are also consistent in the fuzzy matrix $\widetilde{\mathbf{A}}$ (Csutora and Buckley, 2001).

The purpose of AHP and FAHP is to determine the scale vector based on pairwise comparisons, that is, to calculate local and global priorities (step 4). The method for calculating local priorities is illustrated by the example of tasks.

In the classic analytic hierarchy process (AHP), Saaty (1980) proposed the eigenvector method as a way to determine the values of local priorities (which can be approximated using various methods). The most widely adopted methods for determining the values of local priorities include the geometric mean. However, caution is recommended when using it, as the results may be inaccurate if pairwise comparison matrices are larger than 3 × 3. Another example is the normalized arithmetic mean of rows:

*Step 1a.* The pairwise comparison values in matrix **A** are normalized (normalization of columns):

$$s_{ij} = x_{ij} / \sum_{i=1}^{p_k} x_{ij},$$

where $i, j = 1, 2, \ldots, p_k$ (the number of tasks for $k$-th goal, $k = 1, 2, \ldots n$).

[4] For other suggested *RI* values, see e.g. Saaty (1980), Aguaron and Moreno-Jiménez (2003), Alonso and Lamata (2006), Franek and Kresta (2014). *RI* values differ depending on the number of simulations. In studies conducted by Alonso and Lamata [2006], *RI* values are based on 100,000 matrices for each dimension. They also demonstrated that there were no significant differences between *RI* values in the case of 100,000 and 500,000 simulations.

*Step 2a.* Calculating vector $w_i$ by averaging the values in the rows of **A**:

$$w_i = \frac{\sum_{j=1}^{p_k} s_{ij}}{p_k}.$$

The calculated values $w_i$ are the local priorities.

In the fuzzy analytic hierarchy process (FAHP) proposed by Chang (1996), the values of local priorities are calculated as follows:

*Step 1b.* Calculating the fuzzy sum for each row of the fuzzy pairwise comparison matrix $\widetilde{\mathbf{A}}$ and normalizing them using operations on fuzzy numbers:

$$\widetilde{Q}_i = (l_i, m_i, u_i) = \frac{\sum_{j=1}^{p_k} (l_{ij}, m_{ij}, u_{ij})}{\sum_{i=1}^{p_k}\sum_{j=1}^{p_k} (l_{ij}, m_{ij}, u_{ij})}, \quad i = 1, 2, \ldots, p_k;\ k = 1, 2, \ldots, n.$$

*Step 2b.* Calculating the degree of possibility that $\widetilde{Q}_i \geq \widetilde{Q}_g$ $(i, g = 1, 2, \ldots, p_k, i \neq g)$, as per the following formula:

$$V(\widetilde{Q}_i \geq \widetilde{Q}_g) = \mathrm{hgt}(\widetilde{Q}_i \cap \widetilde{Q}_g) = \begin{cases} 1, & \text{for } m_i \geq m_g \\ 0, & \text{for } l_g \geq u_i \\ \dfrac{l_g - u_i}{(m_i - u_i) - (m_g - l_g)} & \text{otherwise,} \end{cases}$$

and selecting the minimum of the above values: $w_i^S = \min V(\widetilde{Q}_i \geq \widetilde{Q}_g)$. Upon normalization, the values $w_i^S$ become the local priorities of tasks for $p_k$ $(k = 1, 2, \ldots, n)$ as a part of sub-goal $k$:

$$w_i = w_i^S / \sum_{i=1}^{p_k} w_i^S.$$

Local priorities $w_i$ for sub-goals[5] and development scenarios[6] are calculated similarly, as in steps 1a and 2a (for AHP) or as in steps 1b and 2b (for FAHP). Local priorities of levels II and III represent the contribution of the given strategic factor (sub-goal and task) to the goal of the next higher level. Local priorities are the basis for calculating global priorities $w_i^g$ which represent the contribution of each strategic factor (on individual levels) to the main goal. The global priority is calculated by multiplying the local priority value of the strategic fac-

[5] Local and global priorities for each sub-goal are identical.
[6] Local priorities of development scenarios are calculated for each task.

tor at each hierarchy level by the global priority value of the related strategic factor at the next higher level.

At the lowest (scenario) hierarchy level, local priorities are multiplied by the corresponding global priorities of tasks. The results, referred to as "partial global priorities", illustrate the contribution of a scenario to the main goal through the implementation of the given task. The sum of all partial global priorities of a scenario is the global priority of that scenario. The values of global priorities for individual scenarios form the basis for selecting the best development scenario. The development scenario with the highest global priority is regarded as the most appropriate one.

## 3 Results of empirical studies

This study is an attempt to assess the strategic factors (goals, tasks and development scenarios) for the Międzychód urban and rural municipality and of the Chrzypsko Wielkie rural municipality (located in Międzychód county) using the classic and fuzzy analytic hierarchy processes. The first step was the establishment of the hierarchy of strategic factors[7] affecting the development of municipalities (Figure 2).

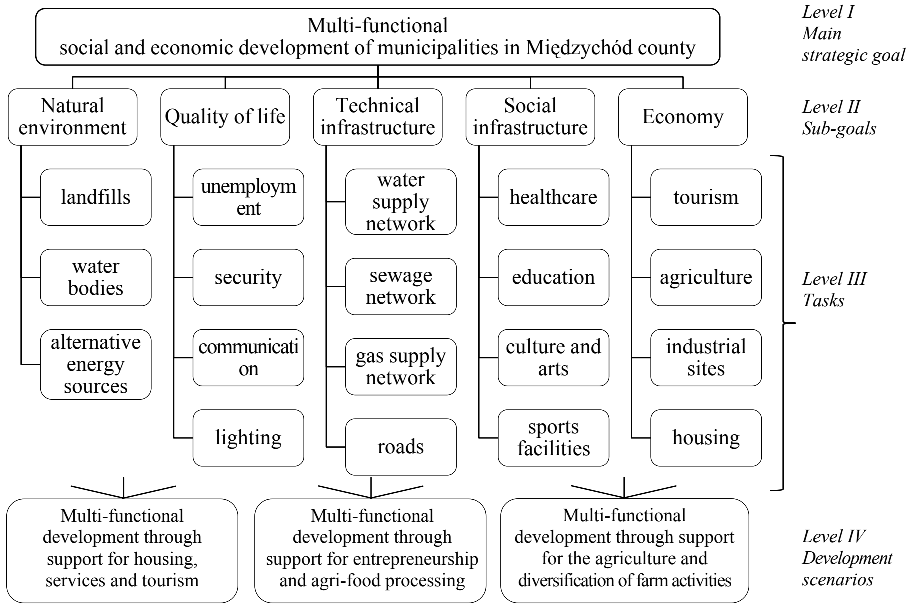


Figure 2. Hierarchy of strategic factors affecting the development of municipalities in Międzychód county

Source: Author's own study based on planning and strategic documents of municipalities in Międzychód county.

[7] The hierarchy includes the most important strategic factors for all municipalities in Międzychód county. One general hierarchy is necessary for comparing strategic factors in different types of municipalities.

The main strategic goal for the municipalities was assumed to be the multi-functional socio-economic development. To achieve the main goal, it is necessary to implement five sub-goals related to: the natural environment, the population's quality of life, the technical infrastructure, the social infrastructure and the local economy. Each sub-goal includes identified packages of strategic tasks which are essential for the attainment of sub-goals.

The following task packages were identified within the sub-goals:

*Sub-goal 1*: environmental protection (natural environment[8])

Tasks:

- solving the waste disposal issues (landfills),
- use of water bodies in the fisheries industry (water bodies),
- use of alternative energy sources (alternative energy sources).

*Sub-goal 2*: improving the population's quality of life (quality of life)

Tasks:

- reducing unemployment (unemployment),
- improving the population's sense of security (security),
- extending and upgrading the communication system (communication),
- improving the street lighting (lighting).

*Sub-goal 3*: expansion and modernization of the technical infrastructure (technical infrastructure)

Tasks:

- expansion and modernization of the water supply network (water supply network),
- expansion and modernization of the sewage network (sewage network),
- expansion and modernization of the gas supply network (gas supply network),
- expansion and modernization of the road system (roads).

*Sub-goal 4*: expansion and modernization of the social infrastructure (social infrastructure)

Tasks:

- improving the condition of the healthcare system (healthcare),
- improving the condition of the education system (education),
- increasing the number of cultural and arts facilities (culture and arts),
- increasing the number of sports facilities (sports facilities).

*Sub-goal 5*: development of the local economy (economy)

Tasks:

- development of tourism (tourism),
- modernization of agriculture (agriculture),

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[8] The terms to be used later in this paper are put in brackets.

- construction of industrial sites (industrial sites),
- development of residential housing (housing).

With these tasks in mind, three alternative development scenarios were developed:

Scenario 1: multi-functional development through support for housing, services and tourism.

Scenario 2: multi-functional development through support for entrepreneurship and agri-food processing.

Scenario 3: multi-functional development through support for agriculture and diversification of farm activities.

The strategic factors were compared pairwise at each hierarchy level by local experts (councillors[9] of the municipalities under consideration). Based on experts' opinions, local and global priorities were calculated for sub-goals, tasks and development scenarios with the use of AHP and FAHP. The method for calculating priorities is illustrated by the example of tasks within the environmental protection goal for the Międzychód municipality.

Table 3: Verbal and numerical assessment of pairwise comparisons between tasks within the environmental protection sub-goal for the Międzychód municipality

| **Councillor** | **Intensity of importance of the first task over the second one: verbal assessment numerical assessment (triangular fuzzy number)** | | |
|---|---|---|---|
| | **landfills/ water bodies** | **landfills/ alternative energy sources** | **water bodies/ alternative energy sources** |
| 1 | weak+<br>4 (2, 4, 6) | weak+<br>4 (2, 4, 6) | equal importance<br>1 (1, 1, 1) |
| 2 | strong+<br>6 (4, 6, 8) | strong<br>5 (3, 5, 7) | strong+<br>6 (4, 6, 8) |
| 3 | strong<br>5 (3, 5, 7) | very strong+<br>8 (6, 8, 9) | weak<br>3 (1, 3, 5) |
| … | … | … | … |
| 13 | strong<br>5 (3, 5, 7) | strong<br>5 (3, 5, 7) | absolute<br>9 (7, 9, 9) |
| 14 | equal importance<br>1 (1, 1, 1) | strong<br>5 (3, 5, 7) | strong+<br>6 (4, 6, 8) |
| 15 | strong<br>5 (3, 5, 7) | strong<br>5 (3, 5, 7) | equal importance<br>1 (1, 1, 1) |
| Geometric mean | 1.995 (1.289; 1.995; 2.775) | 1.900 (1.189; 1.900; 2.764) | 1.256 (0.796; 1.256; 1.786) |

+ Means a slightly stronger intensity of importance if the decision maker is unable to choose between two neighboring ratings.

Source: Author's own study based on the results of a survey with the councillors of the Międzychód municipality in 2013.

9 The number of councilors depends on the number of inhabitants and is set by law (The Act on Commune Self-Government, 1990): 15 councilors for municipalities up to 20,000 inhabitants.

Pairwise comparisons of tasks, presented as linguistic variables, were converted into the corresponding numerical values and averaged using geometric mean (Table 3). These values were arranged into the pairwise comparison matrix in AHP (Table 4), or into the equivalent fuzzy matrix in FAHP (Table 5).

Table 4: Pairwise comparison matrix for tasks under sub-goal 1 and local priority values

| *i* | Tasks | Pairwise comparison matrix for tasks | | | Normalized pairwise comparison matrix for tasks | | | $w_i$ |
|---|---|---|---|---|---|---|---|---|
| | | landfills | water bodies | alternative energy sources | landfills | water bodies | alternative energy sources | |
| 1 | Landfills | 1.000 | 1.995 | 1.900 | 0.493 | 0.526 | 0.457 | 0.492 |
| 2 | Water bodies | 0.501 | 1.000 | 1.256 | 0.247 | 0.264 | 0.302 | 0.271 |
| 3 | Alternative energy sources | 0.526 | 0.796 | 1.000 | 0.259 | 0.210 | 0.241 | 0,237 |
| Total | | 2,027 | 3.791 | 4.156 | 1.000 | 1.000 | 1.000 | 1.000 |

$\lambda_{max} = 3.008$, $RI = 0.5245$, $CI = 0.004$, $CR = 0.76\%$.

Source: Author's own calculations based on the results of a survey with the councillors of the Międzychód municipality in 2013.

Table 5: Fuzzy pairwise comparison matrix for tasks under sub-goal 1

| *i* | Tasks | Fuzzy pairwise comparison matrix for tasks | | | $\widetilde{Q}_i$ |
|---|---|---|---|---|---|
| | | landfills | water bodies | alternative energy sources | |
| 1 | Landfills | (1.000; 1.000; 1.000) | (1.289; 1.995; 2.775) | (1.189; 1.900; 2.764) | (0.264; 0.491; 0.865) |
| 2 | Water bodies | (0.360; 0.501; 0.776) | (1.000; 1.000; 1.000) | (0.796; 1.256; 1.786) | (0.163; 0.276; 0.471) |
| 3 | Alternative energy sources | (0.362; 0.526; 0.841) | (0.560; 0.796; 1.257) | (1.000; 1.000; 1.000) | (0.146; 0.233; 0.410) |

Source: Author's own calculations based on the results of a survey with the councillors of the Międzychód municipality in 2013.

The consistency of pairwise comparisons was also checked. In this case, the inconsistency ratio was 0.76% which means that the pairwise comparisons of tasks under sub-goal 1 for the Międzychód municipality were consistent. Next, the pairwise comparison matrix was used to determine the local priority vectors $w_i$ in AHP (Table 4) and FAHP (Table 6). As shown by the results, the most important task under the environmental protection goal was to solve the landfill issue. The local priorities for this task were 0.492 (AHP) and 0.539 (FAHP) which means that its contribution to the first sub-goal was around 50%. The other two tasks had significantly lower values of local priorities (Tables 4 and 6), and therefore were less important for the attainment of the environmental protection sub-goal than the first task.

Table 6: Calculating the local priorities of tasks in FAHP

| $i$ | $\widetilde{Q}_i$ | | | $g$ | $\widetilde{Q}_g$ | | | $V(\widetilde{Q}_i \geq \widetilde{Q}_g)$ | $\min V(\widetilde{Q}_i \geq \widetilde{Q}_g)$ | $w_i$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | $l_i$ | $m_i$ | $u_i$ | | $l_g$ | $m_g$ | $u_g$ | | | |
| 1 | 0.264 | 0.491 | 0.865 | 2 | 0.163 | 0.276 | 0.471 | 1.000 | 1.000 | 0.539 |
| 1 | 0.264 | 0.491 | 0.865 | 3 | 0.146 | 0.233 | 0.410 | 1.000 | | |
| 2 | 0.163 | 0.276 | 0.471 | 1 | 0.264 | 0.491 | 0.865 | 0.492 | 0.492 | 0.266 |
| 2 | 0.163 | 0.276 | 0.471 | 3 | 0.146 | 0.233 | 0.410 | 1.000 | | |
| 3 | 0.146 | 0.233 | 0.410 | 1 | 0.264 | 0.491 | 0.865 | 0.362 | 0.362 | 0.195 |
| 3 | 0.146 | 0.233 | 0.410 | 2 | 0.163 | 0.276 | 0.471 | 0.850 | | |
| | | | | | | | | total | 1.854 | 1.000 |

Source: Author's own calculations based on the results of a survey with the councillors of the Międzychód municipality in 2013.

The values of local priorities for other tasks, sub-goals and development scenarios are calculated in a similar way. The next step is to calculate the global priorities. In the case of sub-goals, the local and global priorities are the same. Global priorities for tasks are calculated by multiplying the local priority value of a task by the corresponding global priority value of the sub-goal. When multiplied by the values of global priorities for tasks, the local priorities for scenarios become partial priorities. The global priority is determined only after the partial priorities within a scenario have been added together.

Table 7 shows the values of global priorities for sub-goals and tasks for the Międzychód and Chrzypsko Wielkie municipalities. Note that calculations based on AHP and FAHP showed similar values of global priorities. The sub-goals related to the development of the technical and social infrastructure were important to both municipalities. In the Międzychód municipality, the global priority values for the technical infrastructure calculated using AHP and FAHP were 0.228 and 0.223, respectively. For the social infrastructure, the respective values were 0.220 and 0.215. Similarly, in the Chrzypsko Wielkie municipality, the global priority values calculated using AHP and FAHP for the technical infrastructure were 0.222 and 0.219, respectively, and 0.195 and 0.201 for the social infrastructure. In addition to important sub-goals shared between the municipalities, the urban and rural municipality of Międzychód demonstrated the importance of the environmental protection sub-goal (AHP: 0.211, FAHP: 0.214). The rural municipality of Chrzypsko Wielkie, on the other hand, attached importance to improvements in quality of life (AHP: 0.219, FAHP: 0.216) and local economy development (AHP: 0.223, FAHP: 0.216). All these goals are rated as "medium important" by the municipal councillors (with global priority values at around 0.2). Other goals were slightly less important to the municipalities.

The global priority values calculated with FAHP (Table 7) were used to discuss the importance of tasks. In the urban and rural municipality of Międzychód, one of the most important tasks was solving the landfill issue. The global priority of that task was 0.115 which means that its contribution to the main goal was 11.5%. As regards the rural municipality of Chrzypsko Wielkie, the key tasks were reducing the unemployment (a global priority of 0.127) and extending and upgrading the healthcare infrastructure (0.101).

Table 7: Values of global priorities for sub-goals and tasks for the Międzychód and Chrzypsko Wielkie municipalities

| Sub-goals | Międzychód | | Chrzypsko Wielkie | | Tasks | Międzychód | | Chrzypsko Wielkie | |
|---|---|---|---|---|---|---|---|---|---|
| | AHP | FAHP | AHP | FAHP | | AHP | FAHP | AHP | FAHP |
| Environmental protection | **0,211**[a)] | **0,214** | 0,142 | 0,149 | landfills | 0.104 | 0.115 | 0.078 | 0.084 |
| | | | | | water bodies | 0.057 | 0.057 | 0.037 | 0.046 |
| | | | | | alternative energy sources | 0.050 | 0.042 | 0.027 | 0.019 |
| Quality of life | 0,160 | 0,167 | **0,219** | **0,216** | unemployment | 0.054 | 0.056 | 0.107 | 0.127 |
| | | | | | security | 0.048 | 0.055 | 0.044 | 0.043 |
| | | | | | communication | 0.029 | 0.031 | 0.038 | 0.038 |
| | | | | | lighting | 0.029 | 0.026 | 0.030 | 0.007 |
| Technical infrastructure | **0,228** | **0,223** | **0,222** | **0,219** | water supply network | 0.073 | 0.079 | 0.077 | 0.079 |
| | | | | | sewage network | 0.066 | 0.069 | 0.062 | 0.066 |
| | | | | | gas supply network | 0.028 | 0.009 | 0.020 | 0.000 |
| | | | | | roads | 0.062 | 0.066 | 0.063 | 0.074 |
| Social infrastructure | **0,220** | **0,215** | **0,195** | **0,201** | healthcare | 0.071 | 0.076 | 0.084 | 0.101 |
| | | | | | education | 0.070 | 0.087 | 0.058 | 0.077 |
| | | | | | culture and arts | 0.027 | 0.000 | 0.023 | 0.000 |
| | | | | | sport facilities | 0.051 | 0.052 | 0.030 | 0.022 |
| Economy | 0,181 | 0,181 | **0,223** | **0,216** | tourism | 0.035 | 0.036 | 0.045 | 0.043 |
| | | | | | agriculture | 0.054 | 0.053 | 0.079 | 0.075 |
| | | | | | industrial sites | 0.047 | 0.046 | 0.048 | 0.047 |
| | | | | | housing | 0.045 | 0.046 | 0.051 | 0.051 |

[a)] Priority values for the most important sub-goals are in bold.

The highest values of global priorities for tasks $w_i^g \in \langle 0.09; 0.13 \rangle$ are in dark grey; the important tasks $w_i^g \in \langle 0.06; 0.09 \rangle$ are in medium grey; the medium important tasks $w_i^g \in \langle 0.03; 0.06 \rangle$ are in light grey; tasks $w_i^g \in \langle 0; 0.03 \rangle$ which do not have to be urgently implemented are in white.

Source: Author's own calculations based on the results of surveys with the councillors of the Międzychód and Chrzypsko Wielkie municipalities in 2013.

Moreover, the two municipalities attached importance to tasks related to the development and upgrade of the water supply and sewage networks and roads; as well as to tasks involving the upgrade of education facilities. The extension and upgrade of the healthcare infrastructure proved to be important to the

Międzychód municipality. In the rural municipality of Chrzypsko Wielkie two important tasks were identified: solving the landfill issue and developing the agriculture. The global priorities for these tasks fell into the interval (0.06; 0.09⟩.

The use of FAHP allowed also to discover some tasks which do not need to be implemented. In both municipalities, these were increasing the number of cultural and arts facilities. Moreover, the extension of the gas supply network proved not to be necessary in Chrzypsko Wielkie municipality. The global priorities for these tasks were zero.

Table 8: Importance hierarchy of tasks for the Międzychód and Chrzypsko Wielkie municipalities

| **Sub-goals** | **Tasks** | **Międzychód** | **Chrzypsko Wielkie** |
|---|---|---|---|
| | | **FAHP** | **FAHP** |
| Environmental protection | landfills | +++ | ++ |
| | water bodies | + | + |
| | alternative energy sources | + | 0 |
| Quality of life | unemployment | + | +++ |
| | security | + | + |
| | communication | + | + |
| | lighting | 0 | 0 |
| Technical infrastructure | water supply network | ++ | ++ |
| | sewage network | ++ | ++ |
| | gas supply network | 0 | 0 |
| | roads | ++ | ++ |
| Social infrastructure | healthcare | ++ | +++ |
| | education | ++ | ++ |
| | culture and arts | 0 | 0 |
| | sport facilities | + | 0 |
| Economy | tourism | + | + |
| | agriculture | + | ++ |
| | industrial sites | + | + |
| | housing | + | + |

+++ means the most important task; ++ means an important task; + means a medium important task; 0 means a non-urgent task.

Source: Author's own study based on Table 7 data.

In the Międzychód municipality, the most important task was identified (with a global priority value $w_i^g \in (0.09;\ 0.13\rangle$) together with five important tasks ($w_i^g \in (0.06;\ 0.09\rangle$), ten medium important tasks ($w_i^g \in (0.03;\ 0.06\rangle$) and three non-urgent tasks ($w_i^g \in \langle 0;\ 0.03\rangle$). In the rural municipality of Chrzypsko Wielkie, there were two most important tasks, six important tasks, six medium important tasks, and five non-urgent tasks (Tables 7 and 8).

The proposed importance hierarchy of tasks for the municipalities (Table 8), as supplemented with information on funding sources and operators charged with the performance of specific tasks, may be used when drawing up the development strategies for the municipalities.

Table 9: Global priority values for the development scenarios for the Międzychód and Chrzypsko Wielkie municipalities

| Scenarios | Międzychód | | Chrzypsko Wielkie | |
|---|---|---|---|---|
| | **AHP** | **FAHP** | **AHP** | **FAHP** |
| Multi-functional development through support for housing, services and tourism | **0.422** | **0.482** | **0.323** | 0.309 |
| Multi-functional development through support for entrepreneurship and agri-food processing | 0.363 | 0.396 | **0.353** | **0.380** |
| Multi-functional development through support for the agriculture and diversification of farm activities | 0.215 | 0.122 | **0.324** | 0.311 |

Source: Author's own calculations based on the results of surveys with the councillors of the Międzychód and Chrzypsko Wielkie municipalities in 2013.

With these approaches, it was also possible to assess the importance of development scenarios for the municipalities under consideration (Table 9). In the case of the Międzychód municipality, the results of AHP and FAHP analyses were similar. The multi-functional development through support for the housing, services and tourism (with a global priority of 0,422 and 482, respectively) turned out to be the best scenario (Table 9). As regards the Chrzypsko Wielkie rural municipality, the results obtained from AHP did not provide an unequivocal identification of the best development scenario, since the global priorities had similar values (around 0.3). In this case, FAHP proved to be useful in solving this problem as it provided a basis for selecting the development scenario involving multi-functional development through support for entrepreneurship and agri-food processing. The global priority for this scenario was 0.380 (Table 9).

## 4 Summary

In presented approaches, quantitative methods are combined with qualitative experts' assessments. The use of AHP and FAHP allowed to assess the importance of sub-goals, strategic tasks and development scenarios for municipalities based on experts' opinions. Both methods resulted in similar importance ratings of strategic factors. However, FAHP allowed to "sharpen" the values of global priorities as compared to classic AHP which was particularly evident in the assessment of the development scenarios. The classic AHP has failed to unequivocally identify the best scenario for the Chrzypsko Wielkie municipality. This was only possible using FAHP.

In the Chrzypsko Wielkie municipality, the most important scenario involved the development through support for entrepreneurship and agri-food processing. In the urban and rural municipality of Międzychód, the best scenario involved the development through support for housing, services and tourism.

Moreover, the use of FAHP allowed to eliminate the tasks with the lowest strategic importance (global priority equal to zero). Furthermore, based on task importance assessments by local experts, the importance hierarchy of tasks was established to identify the most important ones (priority tasks), important tasks, medium-important tasks and non-urgent tasks.

The proposed approach to the assessment of importance of strategic factors for a municipality can be used in the planning of socio-economic development of administrative units as the underlying reason for building the development strategy.

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