DISCUSSION PAPER

Leibniz Institute of Agricultural Development in Central and Eastern Europe

DELIVERABLE 7.5

"EMPLOYMENT DIVERSIFICATION OF FARM HOUSEHOLDS AND STRUCTURAL CHANGE IN THE RURAL ECONOMY OF THE NEW MEMBER STATES"

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DELIVERABLE 7.5
"Employment diversification of farm households and structural change in the rural economy of the New Member States"

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EXECUTIVE SUMMARY

Intersectoral adaptations in the rural labour market and especially the release of farm labour in favour of rural non-farm employment are recognised as one favourable dimension of structural change. Deliverable D7.5[2] of the SCARLED project looks at the phenomenon of employment diversification in rural farm households of five New Member States (Bulgaria, Hungary, Poland, Romania, and Slovenia) of the European Union. The basis is survey data collected in these five countries in 2007-2008. A theoretical review discusses the optimal use of labour in a household as well as the non-economic motivation for employment diversification. The discussion results in an integrated theoretical framework reflecting the drivers of non-farm employment diversification. Based on this framework a model is developed to analyse a household's potential to diversify its activities.

One critical issue in empirical studies is that survey data are often imperfect. The reasons are manifold. For instance, respondents may lack knowledge on the respective case in question, they may be unwilling to give exact figures, or the qualitative nature of the questions results in rough estimates. Nevertheless, for lack of better alternatives such information is commonly processed as precise data in standard econometric models. Yet, it would be appealing to have a methodology that allows explicitly for imperfect information in the calculation routine. This would acknowledge the imperfect nature of the data and make the deductive reasoning of the recommendations transparent. One methodology that specifically addresses this issue is known as fuzzy logic and roots in Zadeh's fuzzy set theory (Zadeh 1965). Fuzzy sets allow information to be partially true and partially false thus picturing imperfect information. The fuzzy sets are subject to precise mathematical operations that result in a non-fuzzy output value.

Subsequently, deliverable D7.5 of the SCARLED project implements a Mamdani's type fuzzy inference system (Mamdani and Assilian 1975) for assessing household's potential for non-farm diversification. The model consists of ten variables grouped into the four factors: (i) need for diversification, (ii) internal conditions, (iii) external conditions, and (iv) household attitudes towards employment alternatives. These factors cover key variables of the theoretical framework described in SCARLED deliverable D2.1 (Buchenrieder et al. 2007). The four factors are determined by ten variables. Dependency ratio and farm size cause the need for diversification. Age, educational level, and household's labour capacity determine household's internal conditions for non-farm diversification. Remoteness, labour market conditions, and regional purchasing power set the external conditions in which a household operates. Attitudes towards waged and self-employed activities are combined to the factor attitudes towards employment alternatives.

Calculations based on surveys in Bulgaria, Hungary, Poland, Romania, and Slovenia, altogether 1,077 rural farm households, show that the model is congruent with the theoretical assumptions. For three quarters of households, the calculated potential of non-farm diversification is concordant with their actual behaviour. For the fourth quarter the diverging behaviour can be convincingly explained with (1) delayed reactions to changed environments and (2) a strong and exclusive focus of some households on farming. It can therefore be concluded that the model reflects, on the one hand real world situations and,

[2] SCARLED deliverables can be found at www.SCARLED.eu.

on the other hand could be used for simulating conclusively future developments and the impact of policy measures.

Six types of farm households are empirically distinguished. **Households acting under a demand-pull environment** are not under pressure to diversify but have positive attitudes towards diversification. They take advantage of favourable internal and external conditions. **Households enjoying the benefits of a past demand-pull environment** are comparable to the households acting under a demand-pull environment with one exception: they do no longer act under favourable external conditions. **Farmers** are able to sustain their families due to their sufficiently large farms. Regardless their internal and external conditions and attitudes, they do not diversify as they are under no pressure to do so. Otherwise, **distress-push diversifier households** feel more pressure to diversify, but are also more interested in employment outside the agricultural sector. Their attitudes towards employment alternatives are highly positive and their internal conditions are so good that they diversify even when external conditions are not very favourable. **Possible job-starters**, those households having comparatively young members, are under high pressure to diversify and show positive attitudes towards non-farm income activities. However, ambiguous internal or external conditions hamper diversification. **Pensioner households living under distress-push conditions** are under pressure to diversify but unfavourable internal and external conditions prevent income diversification. Also attitudes towards employment alternatives are seldom positive in this group.

The model was used to simulate for the six household types future developments. To show the impact of time without policy interventions, age was increased and the chance of finding a job on the local labour market was decreased. These changes in the input variables simulate less favourable internal and external conditions for the households. Results indicate that distress-push diversifier households and possible job-starters are very likely to become pensioner households living under distress-push conditions while households acting under a demand-pull environment and households that still enjoy the benefits of a past demand-pull environment will tend to concentrate on farming. Pensioner households living under distress-push conditions are expected to face social hardship. Above all, their tiny farms do not generate sufficient incomes and old-age pensions tend to be low, thus it does not surprise that pensioner households are likely to face poverty. Farmers, on the contrary, will be comparatively better off.

These expected developments ought to be anticipated by appropriate policies. Obviously it can never be sufficient to address only one aspect, e.g. education. A multi-perspective approach that takes into account the households' need for diversification, their attitudes as well as the key internal and external employment constraints is more suitable. While attitudes are difficult to change, the diversification pressure as well as internal and external constraints could be addressed by policy measures.

Finely-targeting of policies is a condition for efficient support. Rural farm households are no homogenous group. While some operate on comparatively larger farms or earn substantial non-farm income, others face poverty when their small land plots cannot sustain their livelihoods or they are too old for successfully entering the non-farm labour market. For a remarkable share of households, i.e. those who work on small farms and have a low potential to diversify their income sources, **social policies** are recommended instead of agricultural or rural development measures. Structural change can be promoted without causing social hardship by measures that support farm exit of rural households, whose farming activities are minor compared to their non-farm income. **Training** and **measures addressing the development of non-farm labour markets** could **complement**

such a farm exit measure. For those households, farm support measures and particularly support of investments are not indicated. Sectoral policies, which include co-financing investments is only recommended for farm households with viable farm sizes and the explicit interest and willingness to develop their farm. For these households, **complementing the farm investment support** by **professional training** and **farm extension service** particularly addressing the issue of how to access modern agri-food chains is recommended. Socio-psychological factors are equally important for households' diversification decision. Thus taking these factors into account will make policy measures better adapted to national conditions and more efficient.

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CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF MAPS

LIST OF BOXES

LIST OF EQUATIONS

LIST OF TABLES IN ANNEX

LIST OF ABBREVIATIONS

AKI	Research Institute for Agricultural Economics
BG	Bulgaria
CEE	Central and Eastern European
CEEC	Central and Eastern European countries
CoM	Centre of maximum
CUB	Corvinus University Budapest, Department of Agricultural Economics and Rural Development
EC	European Commission
EU	European Union
HU	Hungary
IAMO	Leibniz Institute of Agricultural Development in Central and Eastern Europe
KU Leuven	Catholic University Leuven
MoM	Mean of maximum
NFRE	Non-farm rural employment
NMS	New Member States
NUTS	*Nomenclature des unités territoriales statistiques* (Nomenclature of Territorial Units for Statistics)
PL	Poland
RO	Romania
SCARLED	Structural change in agriculture and rural livelihoods
Sl	Slovenia
SLF	Sustainable livelihood framework
UL	University of Ljubljana
UNEW	University of Newcastle upon Tyne, Centre for Rural Economy
UNIKENT	University of Kent, Kent Business School
UNWE	University of National and World Economy
USAMVB	Banat's University of Agricultural Sciences and Veterinary Medicine Timisoara
WUDES	Warsaw University, Department of Economic Sciences

1 INTRODUCTION

Changes in the rural labour market, especially the increase of rural non-farm employment are recognised as one dimension of structural change. Labour allocation decisions are driven by economic incentives such as wage differentials, but also non-economic motives may play a decisive role. This paper summarises theoretical insights and presents an integrated conceptual framework reflecting the drivers of employment shifts. Methodologically, the conceptual framework is implemented in fuzzy logic to analyse the household potential to diversify its income activities. The empirical analysis draws on a survey of 1,077 farm households in rural Bulgaria, Hungary, Poland, Romania, and Slovenia.

A number of empirical studies have dealt with factors prompting employment diversification in Eastern Europe (for instance Buchenrieder et al. 2004, Chaplin et al. 2007, Lerman et al. 2008, Möllers 2006, Möllers et al. 2008). These studies used state of the art econometric approaches, such as cluster analysis, logistic regression model, or correlation analysis. These econometric models assume precise knowledge of the living circumstances of the respondents. However, everyone who has ever done empirical work knows that the information collected in structured questionnaires is often imperfect. Notwithstanding the imperfection of the information, the collected data are used in econometric and simulation models as precise data. For the lack of better analytical methods, these approaches gained good results. A methodology, however, that considers the imperfection of information in the estimation routine is appealing. Such a methodology is known as fuzzy logic. This contribution therefore proposes and tests fuzzy logic as an analytical tool for empirical studies.

In fuzzy logic, statements can be partially true and partially false at the same time. This allows for processing imperfect information. The processing routine roots in experts' experiences and is based on natural language. Although fuzzy logic gained much prominence in industrial control technology applications and attracted also the attention of social, environmental, and management sciences, applications in agricultural economics are rare. This study is committed to add further experience to fuzzy logic methodology in agricultural economics and to the theory of rural non-farm employment. Consequently, a fuzzy logic model that assesses non-farm income diversification potential of rural farm households is developed, implemented, tested, and interpreted.

This report is structured as follows: Chapter 2 presents a review of theory, an integrated theoretical framework as well as an overview of current trends of employment diversification. Chapter 3 then introduces fuzzy logic methodology and presents the model that is implemented to assess the non-farm income diversification potential in the survey countries. This is followed by a brief description of the database in Chapter 4. Simulation results are presented in Chapter 5 and Chapter 6. The last chapter summarises the main outcomes and gives policy recommendations.

2 EMPLOYMENT DIVERSIFICATION OF RURAL HOUSEHOLDS – A REVIEW OF THEORY AND CURRENT TRENDS

Rural economic development is often equated with intersectoral changes in the rural labour markets. Especially a decline in farm labour input and an increase in employment outside agriculture are recognised as one dimension of structural change in the rural economy (Jaklič et al. 2009). Thus, beside farm size distribution, tenure systems and changing farm types, developments in terms of diversification and pluriactivity, i.e. labour allocation changes, are attributed to the phenomenon of structural change. The effective direction is not always unambiguous: labour markets determine structural change and vice versa.

This section first introduces some topical terms. It gives then an overview of theories and theoretical approaches that refer to the phenomenon of employment diversification; arguments that directly flow into the model are specifically highlighted. Furthermore, current trends in rural labour markets of the New Member States (NMS) of the European Union (EU) and in particular rural employment diversification are described.

2.1 Definition of topical terms

The rural non-farm sector is widely recognised as one important driving force of rural economic development and as an income source with increasing importance also for farm households. However, the term diversification is not used consistently and needs a short introduction and explanation.

Following Möllers (2006) **employment diversification** is described as a dynamic socio-economic process in which rural households widen the range of income sources in their portfolio. Such diversified incomes are usually based on a mix of farm and non-farm incomes. Employment diversification leads to an increase in the number and mix of income sources. Thus, employment diversification rises with the number of income sources, the equity of their distribution, and their dissimilarity. In other words, a household with three income-generating activities is more diversified than a household with two income generating activities; and a household with two activities, which use 50% of the labour input is more diversified than a household in which the labour input allocation is 90%:10% (Minot 2003). Moreover, the diversification level increases if the income sources are not of the same type.

Furthermore, the term **pluriactivity** is widely used in the literature. It is defined as describing a situation in which an individual pursues more than one income-generating activity or, respectively, the number of income generating activities in a household exceeds the number of economically active household members (Ellis 2000).

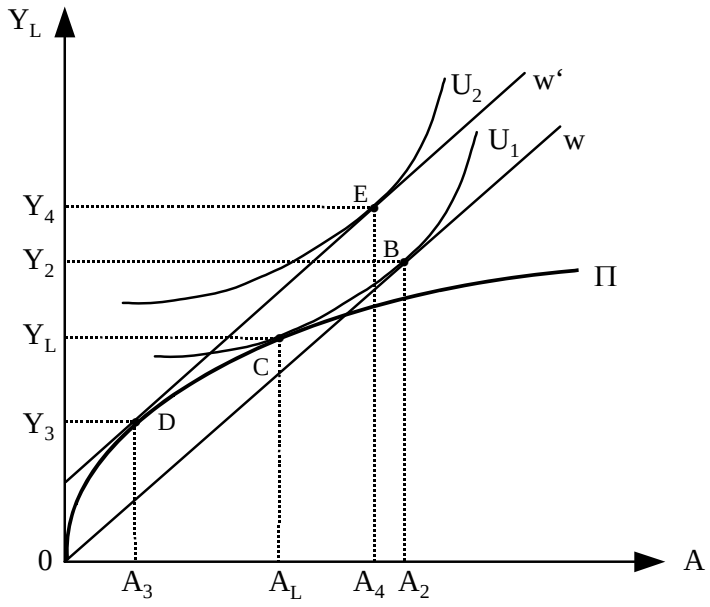
Structural change touches upon all parts of a system, here the agricultural and rural socio-economic system. The structure of the agricultural sector is the result of ongoing changes of the economic, social, cultural, historical, political, technological, and geographical environment. Agricultural structures increasingly encompass the entire sector as well as aspects of the wider rural economy (Buchenrieder et al. 2007). The main stakeholders of structural change in agriculture are embedded within, and interact with, value chains, consumers, wider rural society and economies, institutions and policies (Balmann et al. 2006, Swinnen 2005). Overall, Boehlje (1999: 1028) describes recent developments in structural change as follows: "production is changing from an industry dominated by family-based, small-scale, relatively independent firms to one of larger firms that are more tightly aligned across the production and distribution value chain".

2.2 Theoretical approaches

Theoretical approaches address labour allocation decisions and the optimal labour division of an individual's (household's) working capacity. The seminal works of Todaro (1969) and Harris and Todaro (1970) describe rural-urban movements based on expected income differentials. Furthermore there are many examples of labour supply models based on utility functions (e.g. Henrichsmeyer and Witzke 1991, Sumner 1982). These models look at the case when a household does not exit the farm, but divides its labour between different possible alternatives. Compared to a complete move, i.e. farm exit, this entails much lower adjustment costs. Sumner (1982) finds a strong positive wage elasticity of labour allocation and a high degree of flexibility in the use of operator's labour.

A graphical representation of the optimal distribution of available labour of a farm household is depicted in Figure 1. The optimal use of labour in the farm and non-farm sector depends on farm incomes, opportunity costs and the utility function of a household. The income function Π depicts the income against the labour input. Without a possibility to take up non-farm employment and a given utility function U_1, the household would work A_L hours and earn the income Y_L. In the non-farm sector with a given wage rate w, the household could reach the same utility level with a labour input A_2. The optimal decision is, however, to split labour between farm and non-farm work: The household would then move towards the higher utility function U_2. The tangent of w' touches U_2 in E, which corresponds to the marginal farm income in D. Thus the household should work A_4-A_3 units off the farm and A_3 units on the farm. The combined income Y_4 exceeds those that could be reached if a household concentrated on just one sector.

Figure 1: Optimal use of labour of a farm household



Source: Henrichsmeyer and Witzke (1991: 359).

The special case of distress-push labour movements is modelled by Möllers and Buchenrieder (2005), who show that in the case of incomplete labour markets, the move towards alternative non-farm employment is beneficial for a household even if the expected non-farm wage rate is below the average farm work remuneration. The model refers to two distinct motives of farm households to take up non-farm employment, which arise due to differences within the rural population in terms of individual capital assets and, consequently, in terms of opportunity costs of agricultural labour (Schmitt 1992). The demand-pull direction is motivated by welfare gains triggered by a wage rate that is higher than the average wage rate in agriculture, and the distress-push direction with a wage rate that is no higher or even lower than the average wage rate in agriculture (Möllers 2006). The motivation for distress-push shifts arises from an incomplete agricultural labour market as it is typically found in most developing and transition countries, where high levels of disguised unemployment in farming exist. The model assumes that the income created in the non-farm sector is fully added to the total household income during the early stages. Labour productivity and thus the average wage rate of those remaining in the agricultural sector will increase due to the labour force shifts. Therefore, the incentive to work in the non-farm sector is reduced for those who remain in agriculture.

For the purposes of this study, it is most important to understand, why households decide to diversify their activities. Such motives clearly go beyond wage differences. There are a number of other factors that are discussed as important triggers of non-farm diversification in the literature. Referring to the theoretical framework introduced in the SCARLED deliverable D2.1 (Buchenrieder et al. 2007), these driving forces are presented as part of an integrated framework for the analysis of diversification into non-farm rural employment (NFRE).

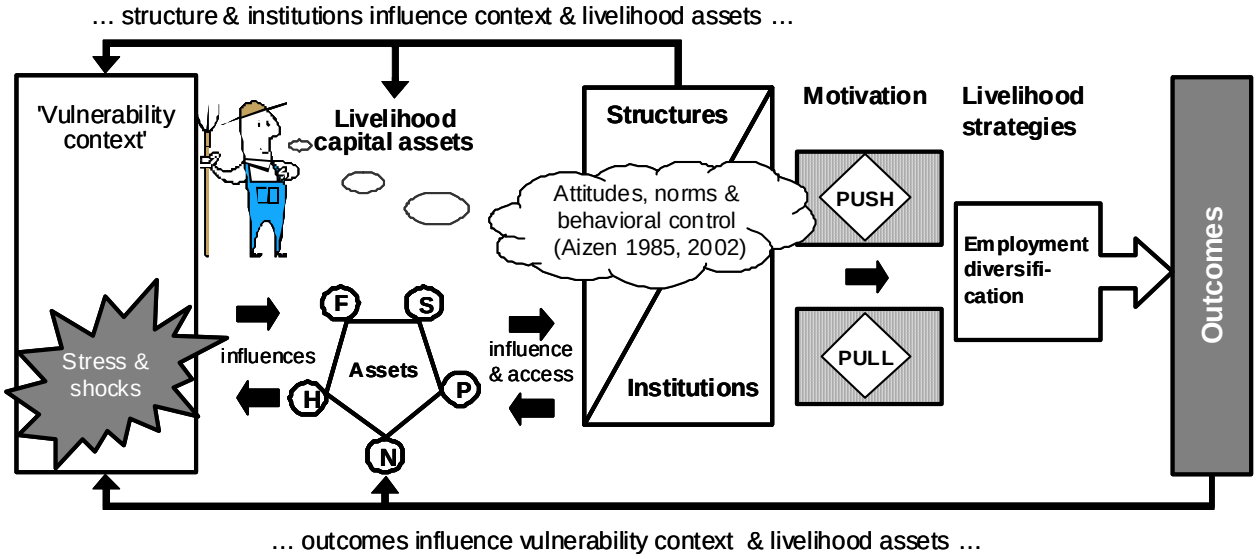
The framework is depicted in Figure 2. It is based on the so-called sustainable livelihood framework (SLF). With its grey-shaded components it represents the natural, social and institutional environment of the decision maker. The concept focuses on action alternatives and constraints. The factors affecting people's access to different forms of non-farm rural employment strongly relate to whether or not and to which extent, people have access to the five forms of capital assets depicted in the asset pentagon, i.e. natural, physical, human, social, and financial assets. These livelihood assets influence and determine access to the socio-economic structure of society at large and their formal and informal institutions.

All components of the SLF influence the decision making process itself. Because neither the SLF nor the related demand-pull and distress-push concepts do address the diversification decision itself, the integrated analytical framework is complemented by the theory of planned behaviour (Ajzen 1985, 1991). Its main components are symbolised within the "thought bubble" in Figure 2. The intention of a certain behaviour depends on three key determinants: attitudes, norms, and control variables.

Cultural and social institutions are essential for the formation of norms. Norms reflect expectations of family and other key persons and thus social pressure. The expected outcome of a specific behaviour determines attitudes. If diversification is seen as an opportunity to increase total household income or change to a better-liked kind of work, this leads to a preference and higher probability of getting involved in alternative employment. Capital assets, structures and market institutions often act as constraints on the subjective control; education, for example could be a constraint in accessing higher level jobs, or high unemployment rates could discourage a persons to start a job search at all.

The vulnerability context points at the importance of uncertainty and risk. In the literature, e.g. McNamara and Weiss (2001) and Mishra and Goodwin (1997) deal specifically with this aspect that motivates households to adapt their employment strategies. More generally, the distress-push and demand-pull approach allows distinguishing two main motivations of employment diversification; depending on the specific components of the SLF, people could be pushed into diversification by unfavourable circumstances or pulled by opportunities in the labour markets and higher wage rates in the non-farm sector. In the context of this study, distress-push variables are included in the analysis under the term "need for diversification" (Section 3.2).

Figure 2: An integrated framework for the analysis of non-farm rural employment



Source: Adapted from Möllers (2006).

Note: F: financial capital, S: social capital, P: physical capital, N: natural capital, H: human capital – these five capital assets constitute the capital asset pentagon.

Individual and household specific characteristics with influence on diversification decisions are mostly part of the livelihood asset pentagon with its five kinds of capital (Figure 2). Among the most prominent of the individual drivers of diversification is education with regard to human capital. Huffman (1980) could show that education leads to a higher probability to decide for non-farm work. Empirical results confirming this are found for example in Goodwin and Mishra (2004), Buchenrieder (2005), Möllers (2006), Alasia and Bollman (2009), Alasia et al. (2009). Other individual characteristics that influence the decision making via the asset pentagon are age, gender, attitudes, experience, and risk aversion. These variables form the internal conditions and attitudes in the model (Section 3.2).

Furthermore, there is a whole set of household and farm characteristics which are potentially influential with regard to entering the non-farm sector. They are also belonging to the household's capital assets such as the household size, wealth and income related variables as well as certain farm characteristics. For example Möllers (2006) shows that farm sizes and per-capita farm incomes influence diversification behaviour. Goodwin and

Mishra (2004) find that the presence of young children reduces the probability that women engage in alternative employment. Alasia et al. (2009) explain that the number of operators on a farm is decisive for the uptake of non-farm work.

Finally, structures and the institutional environment directly influence employment decisions. The regional unemployment rate is found as a significant factor (Alasia et al. 2009); public transport or proximity to urban centres also influence the probability of finding a job and thus diversification (Buchenrieder et al. 2003, Chaplin et al. 2004, Möllers 2006, Traikova et al. 2007). These variables determine the external conditions of diversification in the analysis (Section 3.2).

2.3 Current trends in rural labour markets and employment diversification

The initial share of agriculture in total employment was higher in most of European transition economies than in the more developed EU economies (Lerman et al. 2002). Differences, however, were striking between the countries. Romania and Poland, on the one hand, entered transition with a share of agricultural employment of over 25%. Slovenia, on the other hand, had a share of less than 10% but that is still more than most of the Western European counterparts (Jaklič et al. 2009). In some countries, transition brought a sharp decline in agricultural employment, e.g. Hungary, while in others agricultural employment even increased, e.g. Romania (Swinnen et al. 2005).

It is widely acknowledged that the process of economic development is associated with a declining share of agriculture in total employment. For many years, agricultural employment has been going down in the European Union. In the past years, the decline of agricultural workforce was stronger in the Central and Eastern European (CEE) accession countries than in the EU15. Buchenrieder et al. (2007) report that according to official employment data, during the first five years of transition there was an average reduction of agricultural labour of 35% in the Central and Eastern European countries (CEEC). The strongest reductions occurred in Hungary (57%) and the Czech Republic (46%). A similar decline was recorded for Estonia, an early and radically reforming country, where agricultural labour intensity went down by 58% within the first five years of reform. In contrast, in the first ten years of transition, agricultural employment increased in Romania and Slovenia, while only a modest decline was recorded for Bulgaria (Macours and Swinnen 2000, Rozelle and Swinnen 2004).

Jaklič et al. (2009) discuss the more recent dynamics of the employment structure by sectors (Table 1). As described above, employment in the primary sector is continuing to diminish. This is true regardless of the country or how rural or urban an area is. The pace of decrease, however, tends to be heterogeneous. The sharpest decrease of primary sector employment in the period 2000-2005 was present in predominantly rural areas in Bulgaria, as well as in intermediate regions in Romania. A rather sharp decrease is also obvious in Poland, whereas Hungary and Slovenia experienced the downward trend in primary sector employment to a much lower extent than the EU27 average. Some countries saw an overall increase in agricultural employment since 1990, e.g. Bulgaria, Romania, and Slovenia. In the period 2000-2005, however, all countries shown in Table 1 experienced an overall decline in agricultural employment. Thus, it is probable that the strong initial increase is still not overcome in some countries (Csaki and Lerman 2001).

Table 1: Change in the structure of employment in predominantly rural, significantly rural and predominantly urban areas by sectors between 2000 and 2005 in selected countries

		Bulgaria	Hungary	Poland	Romania	Slovenia	EU27
PR	Primary sector	-18.5	-2.5	-10.6	-8.4	-2.0	-6.3
	Secondary sector	4.3	-0.1	2.3	3.0	-1.5	0.5
	Tertiary sector	14.2	2.6	8.3	5.4	3.4	5.8
SR	Primary sector	-2.6	-1.1	-7.6	-12.5	-1.3	-2.0
	Secondary sector	-1.1	-1.2	-0.2	6.1	-3.5	-0.8
	Tertiary sector	3.8	2.3	7.8	6.3	4.7	2.8
PU	Primary sector	-3.4	-0.4	-6.7	-4.6	n.a.	-0.5
	Secondary sector	-3.3	-2.5	-0.7	-4.1	n.a.	-0.9
	Tertiary sector	6.7	2.9	7.4	8.7	n.a.	1.8

Source: Jaklič et al. (2009).

Note: PR: predominantly rural, SR: significantly rural, PU: predominantly urban, n.a.: not applicable.

With view to future developments, the European Commission (EC) estimates that the agricultural workforce in the EU15 will decrease by around one-third in the coming two decades (Buchenrieder et al. 2007). Regardless of the overall declining importance of agricultural employment, farming remains and will remain a crucial source of income, particularly, in the poorest and least developed CEE regions (Buchenrieder et al. 2009a). At the same time, non-farm income sources will be more and more integrated into farm households' income portfolios. Already today, rural households in Europe's transition economies depend to a high degree (often between 30-50%) on non-farm income sources (Buchenrieder et al. 2009b). Their income portfolios are often highly diversified due to various reasons. First of all, the former socialist countries have a tradition of non-farm activities in rural areas (Greif 1997). Nowadays, these countries are still suffering from the transition shock which led to a sharp decline in production and employment and an increase in poverty. One of the main drivers of employment diversification during transition is the so called distress-push dynamic. Although there are clear signs of recovery and economic development, particularly the unemployment rates in rural areas remain high. Furthermore, there is still a lack of rural infrastructure, capital for investments and highly skilled labour force (Buchenrieder et al. 2009b, Swinnen et al. 2001)

Statistical data and empirical studies on the diversification of rural employment in transition economies are still patchy. It is estimated that between 30-50% of rural incomes in Europe's transition economies are derived from non-farm activities with local incomes playing a bigger role than urban income sources (Greif 1997, Network of Independent Agricultural Experts in the CEE New Member States 2004). Table 2 gives some examples. Part-time employment and activities which are not registered often do not appear in official statistics and Lanjouw and Lanjouw (1997) think that the importance of the non-farm sector is often underestimated. Nonetheless, its crucial role for rural development is unquestioned. It is based on the close relationship with the farming sector as well as its high potential to address the problem of structural change and unemployment in rural areas.

Table 2: The importance of non-farm income sources in Europe's transition economies

Country (year)	Share of non-farm income in total rural incomes (%)	Source
Czech Republic (?)	15	(4)
Hungary (?)	17	(4)
Slovakia (?)	20	(4)
Armenia (2001)	31**	(3)
Lithuania (2001)	34	(1)
Estonia (2001)	41	(1)
Poland (1998)	41*	(1)
Romania (2001)	42**	(3)
Slovenia (2006)	35**	(5)
Macedonia (2001)	49**	(2)
Georgia (2001)	55**	(3)
Bulgaria (2001)	68**	(3)
Croatia (2006)	31**	(5)

Source: (1) Network of Independent Agricultural Experts in the CEE New Member States (2004), (2) Möllers (2006), (3) Davis et al. (2004), (4) Greif (1997), (5) Möllers et al. (2009).

Notes: *Includes paid agricultural employment.
**The data refers to case regions and not to the national level.

3 MODELLING THE DIVERSIFICATION POTENTIAL OF RURAL FARM HOUSEHOLDS

Everyone who has ever done empirical work knows that respondents often only reveal imperfect information. Different cases of imperfection can be observed. The first and surely most obvious one is that the respondents do not know the correct answer to a question they are asked (Box 1).

Box 1: Hypothetical interview 1

Interviewer:	I would like to know what the highest degree of formal schooling of your household members is.
Respondent:	I finished primary school and my wife too. My son was at the university and my daughter finished an apprenticeship as office clerk last year.
Interviewer:	Do you know which degree your son got at the university?
Respondent:	He was five years there and he got a certificate.
Interviewer:	Was it a Bachelor or a Master degree?
Respondent:	No, no, it was a university degree.

In the hypothetical interview 1 (Box 1) the respondent does not know, whether and if yes which university degree his son achieved because he is not familiar with the concept of Bachelor and Master. For the father it is simply a university degree. The interviewer has now different options. He could leave an empty space and risk that he will be rebuked for not being able getting an answer to a simple question. Without doubt, most interviewers will try to avoid this. Hence, there are two options left. He could force the father forward to get an answer by explaining the differences between Bachelor and Master degree. The answer will most probably be an estimation coloured from the wish of a proud father to have provided his son with the best education he could get. The second option is to use the information that the son had studied for five years to decide that it is a Master degree due to the time span. In both cases the information is imperfect. The second and most delicate case of imperfection arises when the respondents are reluctant to give correct figures although they know them (Box 2).

Box 2: Hypothetical interview 2

Interviewer:	I would like to know something about your household income. You said that you have a car and that you offer from time to time transport services to other persons in your village. Could you tell me please how much you earn with this service in an average year?
Respondent:	I do not always ask for money. Sometimes, I take what the passenger freely offers. I think it is not really a business and therefore there is no income.
Interviewer:	Yes, I understand. But how much do you get approximately per month from the service?
Respondent:	Oh, last month was not a good one.
Interviewer:	What is a bad month?
Respondent:	Well, it was ten units.

In the hypothetical interview 2 (Box 2) the respondent most likely has a good estimate on how much he earns with his taxi service but he does not like to provide detailed figures. The answer "ten units" is obviously not exact but the interviewer has no other option but to accept it. These types of problematic answers are well known and will occur in a similar way whenever the issue of income data is touched. Subsequently, the information in the data base is imperfect in the way that the income data are biased. The last case of imperfection refers to qualitative answers ranging from e.g. "very good" to "very bad" or "low" to "high".

Box 3: Hypothetical interview 3

Interviewer: How good are the streets in your region?

Respondent: Five years ago, I had to pay much money because my wife hit a pothole and spoiled the axle. But last year the street was reconstructed and now I think it is good.

Contrary to the first two hypothetical interviews, the information given in the hypothetical interview 3 (Box 3) is by its very nature imperfect because everyone may have a different perception of what a "good street" should look like. The same street could be rated as "poor" from someone who is used to Italian motorways or "very good" from people who are used to dirt roads. For analytical purposes such information is usually coded into an ordinal scale from one to five, e.g. a Likert scale. The resulting value pretends a precise figure that in fact simply does not exist. Nevertheless, such information is often used because people feel comfortable answering them and thus the enumerator faces fewer problems to motivate the respondents to keep interested and concentrated.

Notwithstanding the imperfection of the information, the collected data are used in econometric and simulation models as precise data and the results are generalised. No doubt that this methodology gained good results in the last decades but it would be appealing to apply a methodology that considers the imperfection of information in the estimation routine. Such a methodology is fuzzy logic.

Section 3.1 gives an overview of the key ideas of fuzzy logic and describes how a fuzzy inference system works. Section 3.2 explains how the integrated framework for the analysis of non-farm rural employment from Figure 2 is implemented in a fuzzy logic model while Section 3.3 provides technical details of the model.

3.1 Fuzzy logic – The concept of working with imperfect information

Fuzzy logic gained increasing prominence in the last decade. One reason may be the rapid development of hardware and software that makes it more comfortable to develop and run fuzzy logic systems. However, the basic article for the concept of fuzzy logic dates back more than forty years. In 1965 Lofti A. Zadeh published his article "Fuzzy sets" and became the father of the fuzzy set theory. This theory opened the opportunity to include imperfect information into precise data processing routines. To be clear, it is not the methodology that is fuzzy but the data that is processed. The methodology itself is rooted in well-defined mathematics.

Three kinds of imperfection are distinguished: (i) vagueness, (ii) imprecision, and (iii) uncertainty (Kruse et al. 1995). Information is vague when it could be interpreted from different people or in varying contexts in different ways. Linguistic statements like the one

in the hypothetical interview 3 (Box 3) are vague data. Information that cannot be observed with optional accuracy is called imprecise. The income data are the most prominent example for this kind of imperfection in empirical research in economics (hypothetical interview 2 in Box 2). Uncertain information is subject to random events like lottery results or caused by subjective estimations. The answer given in the hypothetical interview 1 (Box 1) could be rated as uncertain information.

Whatever the kind of imperfection is, all imperfect information share the characteristic that they cannot be rated as true or false but as partially true and partially false. Classical set theory allows only for true or false statements and operates with so-called **crisp sets** – each datum belongs only to one set[3], i.e. the statement that the street's condition is "good" implies that the datum belongs to 100% to the set "good" (Equation 1).

Equation 1: Crisp set

$$\mu_{good}(street\_condition) = \begin{cases} 1 & if\ street\_condition = "good" \\ 0 & if\ street\_condition \neq "good" \end{cases}$$

Source: Own equation.

For processing imperfect information, sets are needed to which a datum belongs only to a certain degree, i.e. the street's condition may be to 80% "good", to 10% "average", and to 10% "very good". This results in what is called **fuzzy sets**, i.e. the datum belongs to 80% to the set "good", to 10% to the set "average", and the 10% to the set "very good" (Equation 2). By this, a statement can be partially true and partially false at the same time. The degree to which a datum belongs to the various sets is defined by the so-called membership functions. The membership functions are at the core of fuzzy set theory and their definition could be seen as the most delicate task in developing a fuzzy logic system. The fuzzy sets are subject to mathematical operations that result in a crisp output.

[3] The authors are aware that mathematicians may challenge the term "to belong to" as imprecise. Nevertheless, in this contribution it is used for simplicity. The precise term would be: "Each datum is 100% a member of only one set" for crisp sets and for fuzzy sets: "The datum is 80% a member of the 'good' set."

Equation 2: Fuzzy sets

$$\mu_{very\_poor}(street\_condition) = \begin{cases} 0.9 & if\ street\_condition = "very\ poor" \\ 0.1 & if\ street\_condition = "poor" \\ 0.0 & if\ street\_condition = "average" \\ 0.0 & if\ street\_condition = "good" \\ 0.0 & if\ street\_condition = "very\ good" \end{cases}$$

$$\mu_{poor}(street\_condition) = \begin{cases} 0.1 & if\ street\_condition = "very\ poor" \\ 0.8 & if\ street\_condition = "poor" \\ 0.1 & if\ street\_condition = "average" \\ 0.0 & if\ street\_condition = "good" \\ 0.0 & if\ street\_condition = "very\ good" \end{cases}$$

$$\mu_{average}(street\_condition) = \begin{cases} 0.0 & if\ street\_condition = "very\ poor" \\ 0.1 & if\ street\_condition = "poor" \\ 0.8 & if\ street\_condition = "average" \\ 0.1 & if\ street\_condition = "good" \\ 0.0 & if\ street\_condition = "very\ good" \end{cases}$$

$$\mu_{good}(street\_condition) = \begin{cases} 0.0 & if\ street\_condition = "very\ poor" \\ 0.0 & if\ street\_condition = "poor" \\ 0.1 & if\ street\_condition = "average" \\ 0.8 & if\ street\_condition = "good" \\ 0.1 & if\ street\_condition = "very\ good" \end{cases}$$

$$\mu_{very\_good}(street\_condition) = \begin{cases} 0.0 & if\ street\_condition = "very\ poor" \\ 0.0 & if\ street\_condition = "poor" \\ 0.0 & if\ street\_condition = "average" \\ 0.1 & if\ street\_condition = "good" \\ 0.9 & if\ street\_condition = "very\ good" \end{cases}$$

Source: Own equation.

Sivanandam et al. (2007) quotes many applications of fuzzy logic. Most prominent are the industrial and control applications but fuzzy logic also encroached upon expert systems. Smithson and Verkuilen (2006) give an overview of fuzzy logic applications in social

sciences. However, it is quite new in agricultural economics. Thus, a review of topical journals[4] showed that there is no article that applied fuzzy logic methodology. So far, only three dissertation theses (Blair 2007, Bosma 2007, Reys 2003) use fuzzy logic in agricultural economics. Reys (2003) applies a fuzzy linear programming model to maximise income of peasant households in an ecologically sensitive region in Brazil. He considers in his work various income activities including non-farm employment. Nevertheless, non-farm income diversification is not the focus of his thesis but the development of farming systems that allow sustainable use of resources within an ecologically sensitive area. Bosma (2007) implemented a fuzzy inference system to simulate the production decision of Vietnamese peasant households for various agricultural products. Non-farm income sources are not considered in his model. Blair (2007) constructs a fuzzy indicator for assessing poverty of farming families in Guyana and develops a fuzzy linear programming model for simulating the impact of different farming based development strategies on family's income. Although non-farm income was considered an income activity in the model, it was not subject to optimisation.[5] Having said this, it could be concluded that fuzzy logic has been used successfully to analyse micro data but the fuzzy models did not explicitly simulate the household potential to diversify into non-farm activities. This research work aims at developing such a model.

Compared to common testing statistical methods the advantages of fuzzy logic are as follows (MathWorks 2001: 1-4 and 1-5):

Fuzzy logic is conceptually easy to understand.

1. Fuzzy logic is flexible.
2. Fuzzy logic is tolerant of imprecise data.
3. Fuzzy logic can model nonlinear functions of arbitrary complexity.
4. Fuzzy logic can be built on the top the experiences of experts.
5. Fuzzy logic can be blended with conventional control technique.
6. Fuzzy logic is based on natural language.

Especially the third, fifth, and seventh point motivated the authors to apply fuzzy logic in this context.

In general, a fuzzy inference system works in the three steps (Figure 3):

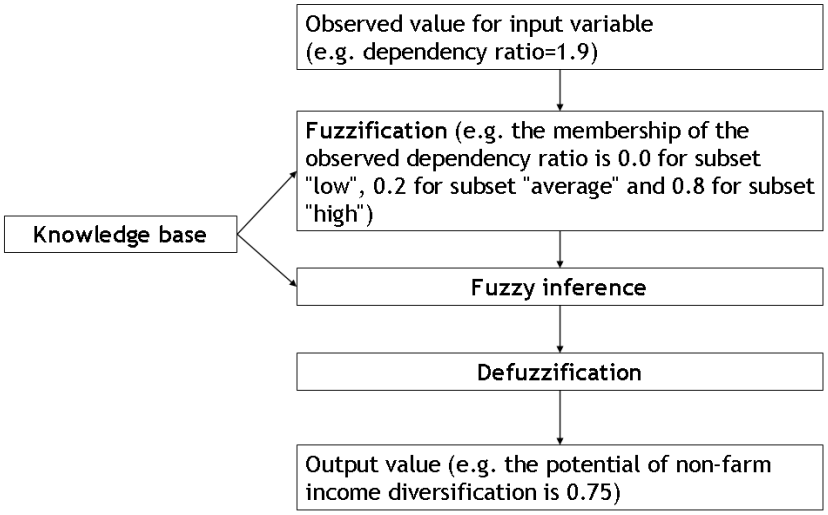
1. Fuzzification,
2. Fuzzy inference, and
3. Defuzzification.

[4] The review was done in Journal of Agricultural Economics, European Review of Agricultural Economics, American Journal of Agricultural Economics, Agricultural Economics, Australian Journal of Agricultural Economics, Post-Communist Economies, Review of Agricultural Economics, and Canadian Journal of Agricultural Economics.

[5] Blair (2007) mentions that off-farm income is of minor importance for family income in his sample.

Systems that follow this structure are called Mamdani's type fuzzy inference systems (Mamdani and Assilian 1975). The idea behind the three steps of a fuzzy inference system is explained more detailed below. There is a second type, the so-called Sugeno's type fuzzy inference systems (Sugeno 1985) for which defuzzification is not necessary because fuzzy inference does not result in a fuzzy output set but in a crisp value or function (Sivanandam et al. 2007).

Figure 3: Overview of the Mamdani's type fuzzy inference system

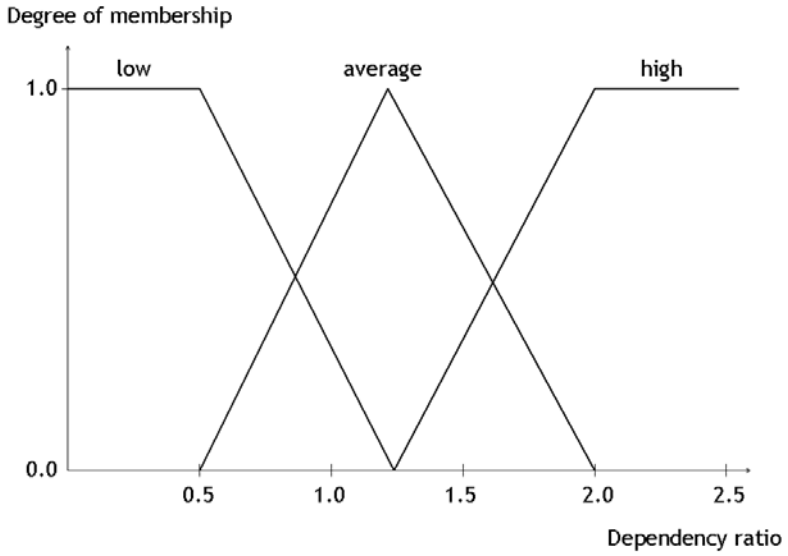


Source: Own figure in adaptation of Kruse et al. (1995: 164).

Note: The input values for the system are crisp, e.g. the observed dependency ratio in the hypothetical household here is 1.9. Even the output value is crisp, i.e. the potential of non-farm income diversification is 0.75.

In the **fuzzification** step the degree of membership for an input value in the defined fuzzy subsets of the respective variable is determined according to the membership functions (Figure 4 and Equation 3). An observed dependency ratio of 1.9 from Figure 3 belongs to 0.0 to the fuzzy subset "low", to 0.2 to "average", and to 0.8 to "high" (Figure 4 and Equation 3).

Figure 4: Graphical representation of the membership functions for the variable "dependency ratio"



Source: Own figure.

Equation 3: Mathematical representations of the membership functions for the variable "dependency ratio"

$$\mu_{low}(dep\_ratio) = \begin{cases} 1 & if\ dep\_ratio < 0.5 \\ -1.33 * (dep\_ratio - 1.25) & if\ 0.5 \le dep\_ratio \le 1.25 \\ 0 & if\ dep\_ratio > 1.25 \end{cases}$$

$$\mu_{average}(dep\_ratio) = \begin{cases} 0 & if\ dep\_ratio < 0.5 \\ 1.33 * (dep\_ratio - 0.5) & if\ 0.5 \le dep\_ratio < 1.25 \\ 1 & if\ dep\_ratio = 1.25 \\ -1.33 * (dep\_ratio - 2.0) & if\ 1.25 < dep\_ratio \le 2.0 \\ 0 & if\ dep\_ratio > 2.0 \end{cases}$$

$$\mu_{high}(dep\_ratio) = \begin{cases} 0 & if\ dep\_ratio < 1.25 \\ 1.33 * (dep\_ratio - 1.25) & if\ 1.25 \le dep\_ratio \le 2.0 \\ 1 & if\ dep\_ratio > 2.0 \end{cases}$$

Notes: The membership functions refer to the three fuzzy subsets "low, "average", and "high" for the variable dependency ratio in Figure 4.
dep_ratio: dependency ratio

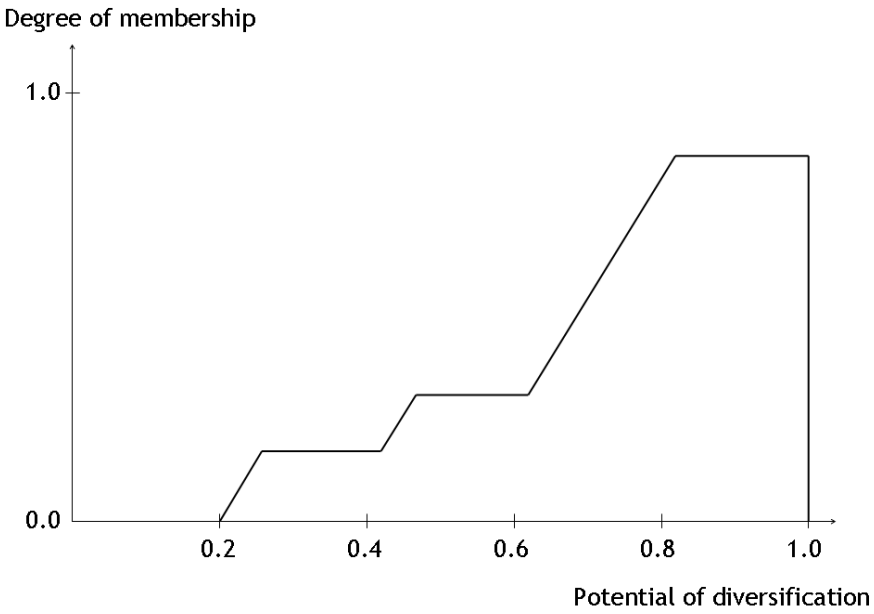
Source: Own equations.

Fuzzy inference is the calculation step of the system. It analyses all rules and results in a fuzzy set for the output variable (Figure 5). Rules link the input variables with the output variable and have the following form:

> **IF** <input variable1> **IS** <input variable1 fuzzy subset> **AND** <input variable2> **IS** <input variable2 fuzzy subset> **THEN** <output variable> **IS** <output variable fuzzy subset>, e.g.
> **IF** dependency ratio **IS** high **AND** farm income **IS** low **THEN** diversification **IS** high

The rules and the membership functions are part of the **knowledge base**. There are different methods discussed in literature how the knowledge base could be built up (Sivanandam et al. 2007, Smithson and Verkuilen 2006).

Figure 5: Output of fuzzy inference



Source: Own figure.

The **defuzzification** step transforms the fuzzy output set into a crisp value for the output variable. Theoretically each method that summarises the fuzzy output area from Figure 5 in a single figure could be applied. In the technical literature (Kruse et al. 1995, Nguyen and Walker 2000, Sivanandam et al. 2007), several methodologies are described. The most commonly used methodologies in industrial applications are the centre of maximum (CoM) and the mean of maximum (MoM) method (fuzzyTECH 2007). The CoM method computes "a crisp output as a weighted average of the term membership maxima, weighted by the inference results" (fuzzyTECH 2007: 120). The MoM method computes the crisp output "only for the term with the highest resulting degree of support" (fuzzyTECH 2007: 121). The CoM method is valued for its compromising feature while MoM is appreciated for its high degree of plausibility. For the fuzzy output set in Figure 5, the household's potential of

diversifying into non-farm activities is 0.7 when the CoM method is used for defuzzification and 0.9 for the MoM method.

3.2 The model design

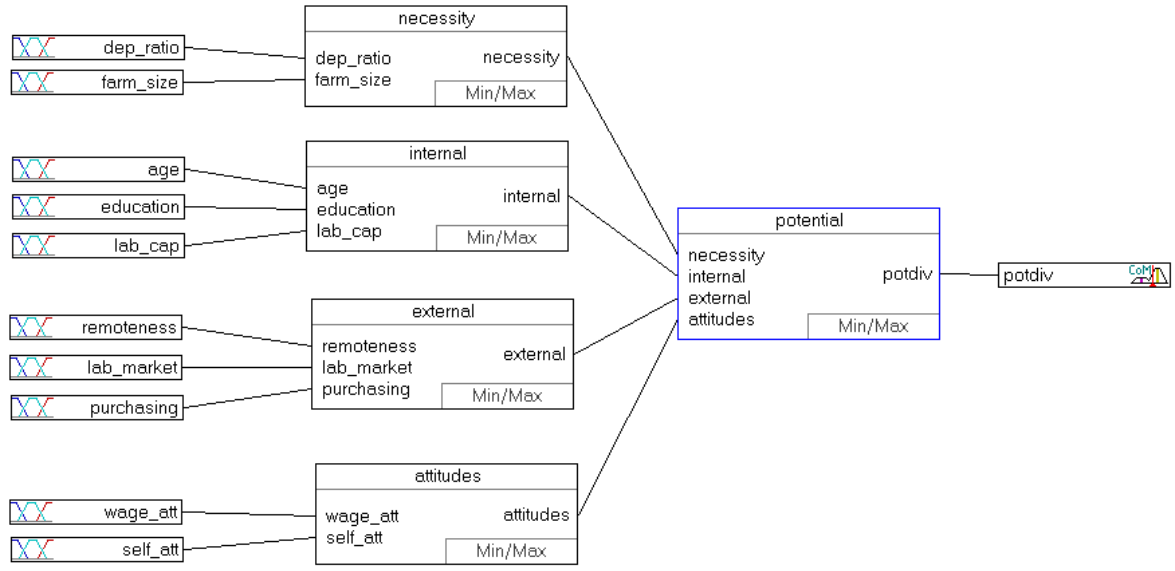
The integrated framework from Figure 2 is too comprehensive to be completely implemented in a fuzzy logic model that is developed from scratch in this project. Nevertheless, the input variables are selected in a way that the final model touches most aspects of the framework and underlying theories from Section 2.2.

Ten variables are used to determine the potential of a household to diversify into non-farm activities. To keep the model's structure comprehensive these variables are grouped into the four factors: (i) need for diversification, (ii) internal conditions, (iii) external conditions, and (iv) attitudes towards employment alternatives (Figure 6). In the following, each factor and its variables are shortly discussed in the context of the integrated framework of Figure 2.

The **need for diversification** is defined as the economic pressure that a household faces. It is closely linked to the so called distress-push factors. In the model, it depends on two key factors: (i) the income that a household can achieve with farming and (ii) the number of household members that have to be supported from this income. Households with a high agricultural income and few dependent household members feel less pressure to diversify. As a proxy indicator for the agricultural income that the household could earn, the farm size is used in the model. The farm size - measured in available hectares of land - stands for natural assets in the SLF. The second variable that determines the need for diversification in the model is the dependency ratio. It is supposed that it is not primarily the number of household members that pushes a household into non-farm diversification but the relation of dependent household members to economically active ones. Economically active persons could migrate and sustain themselves but especially children and sometimes pensioners do not have this opportunity and must be supported by the economically active household members. The dependency ratio is closely related to the distress-push motivation of rural households and, implicitly, is also representative for the human capital in the asset pentagon.

Farm size is an often discussed variable in NFRE literature. Reardon et al. (2007) reviewed various studies and conclude that the effect of farm size is ambiguous in the way that households operating larger farms may be more able to start-up non-farm activities but may be less interested in it due to a lower need for diversification. Csaki and Lerman (2002) found a strong negative correlation between farm size and non-farm income and conclude, that households with a significant share of non-farm income in household income own on average less than 4 ha land. This finding is also supported by the findings of Chaplin et al. (2007) and Möllers (2006), who state that non-farm employment diversifiers have smaller farms. The dependency ratio is less frequently used than the number of household members, economically active household members, and dependent household members. Möllers (2006) used the dependency ratio to explain diversification behaviour but did not find a significant effect. Chaplin et al. (2007) found that households with more children are more likely to diversify their income sources and Möllers et al. (2008) found that the number of household members is positively correlated to non-farm income.

Figure 6: Structure of the fuzzy logic diversification potential model



Source: Model's graphical representation taken from fuzzyTECH.

Internal conditions describe the actual ability of a household to diversify. They work as a switch in the demand-pull and distress-push concept because they determine whether a household could grab favourable opportunities to earn a higher income or whether the family will stay in low income activities. It is unquestionable that elderly people do not tend to alter their living situation. But even if they should have the wish to find a job, they will usually find themselves confronted with labour market constraints. But age is not the only limiting variable; also people with a low education may find it difficult to get a waged job or to start up an own business due to insufficient skills. Labour capacity is also representative for human capital. Last but not least, the labour capacity of a household determines its ability to earn additional income. Wage-employment in rural regions sometimes implies commuting long distances and also self-employment normally goes along with a considerable work-load, exceeding an eight-hour day. Whether it is a wage job or a self-employed activity, long absence on business is usually the result. Households with small children or elderly people in need of care must have at least two economically active persons to save the labour capacity for non-farm diversification. In the model, the variables age, education, and labour capacity determine the internal conditions of a household to diversify.

The high importance of education is confirmed by many studies, e.g. Chaplin et al. (2004), Ellis (1998), Möllers (2006), and Reardon et al. (2007) see positive effects of education on households' diversification behaviour. Chaplin et al. (2007) state that non-farm diversifier households are headed by younger people. Reardon et al. (2007) see a high importance of household labour capacity for non-farm employment.

The **external conditions** refer to the economic environment of a household and the possibilities they offer to diversify. The factor summarises variables that define whether the household is in a demand-pull situation or not. The key question in terms of external conditions is whether there is a demand for paid labour or products that could be offered by a family business in the respective region. Thus, it touches three areas: first, the rural

labour market which is part of the institutional framework under which a household operates, second, local demand, and third, the remoteness of a location. The latter is often determined by an unfavourable basic infrastructure, part of the physical assets in the SLF. Citizens of remote areas face greater difficulties to get a waged employment even if they are willing to commute, and migrating may not be an option. Even for self-employed activities there may be, on the one side, only limited market capacities to earn a decent income and, on the other side, it may be difficult to attract skilled employees. Besides the remoteness of the village, the labour market situation is used as an indicator for wage job opportunities in the model. The local demand for additional products or services from profit-oriented business will be approximated by the regional purchasing power.

Reardon et al. (2007) stress the high importance of regional economic growth for the demand for labour and creating consumption. They also found that returns from non-farm activities are highest near towns.

Even if the household feels the need to earn an additional income, the internal conditions are favourable, and the external conditions make diversification possible, the decision what is actually done depends to a high degree on what is called socio-psychological factors. Is farm work seen as promising or do young people generally strive for less dirty and hard white-collar jobs? Is there a culture of entrepreneurship or is it rather the civil servant with a pension who is admired? What says the old patriarch when his granddaughter migrates to the big city? This is a large field and it is not the focus of this model to be exhaustive in the used variables. However, it is assumed that the factors that are described in the integrated framework, i.e. attitudes, norms and subjective control, play an important role. Therefore, the factor **attitudes towards employment alternatives** is included in the model. Due to the fact that the attitudes towards self-employment may be diametric to the ones towards wage employment, both attitudes are used in the model.

Using socio-psychological variables in explaining economic phenomena is still unusual. Among the pioneers, Davidova et al. (2009), Gorton et al. (2008), and Möllers (2006) may be termed. Möllers (2006) applied in her work comparable attitudes variables and found for instance that a positive attitude towards waged employment influences the intention to give up farming in Macedonia.

All four factors in their various combinations determine the potential that a farm household has for the diversification of its non-farm income activities.

3.3 Implementation

The model from Section 3.2 was implemented as a Mamdani's type fuzzy inference system[6] (Mamdani and Assilian 1975) using the software fuzzyTECH. A graphical overview of the system is given in Figure 3. The core of the system is the knowledge base. It includes for each variable the codomain, the number of fuzzy subsets, a linguistic term and the membership function for each fuzzy subset, and the rules for fuzzy inference.

For constructing the membership function the formalistic approach is used. This approach maps the observed values of the respective variable into a membership scale by assigning the membership degrees 0 and 1 to observed values for which the non-membership or membership is obvious and bridging the cap by a smooth function (Smithson and Verkuilen 2006). This method is expert knowledge based and was applied by Blair (2007). It results in Z-shaped membership functions for the first fuzzy subset, S-shaped ones for the last fuzzy subset, and triangular membership functions for all other fuzzy subsets of a fuzzy variable. The rules were set based on theory as described in Section 2.2, on results from earlier studies published (Section 3.2), and on the project team's expertise. The final model has 41 membership functions and 99 rules.

The model architecture is described in Section 3.3.1 followed by the knowledge base in Section 3.3.2. Symbols and abbreviations for the model are listed in the Annex.

[6] The alternative, a Sugeno's type fuzzy inference system (Sugeno 1985), was not implemented because such a system asks the developer to summarise the rules without a defuzzification step to a crisp output value. This means, the modeller has to determine a crisp value or a crisp function, which would result in a crisp value showing what the potential of non-farm income diversification for a household with a given set of characteristics would be. That information is the fuzziest in literature and crisp information that would allow presuming household's potential with this precision is not available. Furthermore, with the Mamdani's type fuzzy inference system, the authors can profit most from the advantages of fuzzy logic methodology, i.e. tolerance to imprecise information, expert knowledge based, and procession of natural language.

3.3.1 Model architecture

The general model architecture is given in Equation 4.

Equation 4: General model architecture

$$\Xi \rightarrow \mathbf{Y}$$
$$\Xi = \{\xi(1),\ldots,\xi(n)\}$$
$$\mathbf{Y} = \{\upsilon(1),\ldots,\upsilon(o)\}$$
$$x(i) \in X(i), \quad X(i) = [a_{X(i)}, b_{X(i)}], \quad x(i), a_{X(i)}, b_{X(i)} \in \Re, \quad i = 1,\ldots,n$$
$$y(j) \in Y(j), \quad Y(j) = [a_{Y(j)}, b_{Y(j)}], \quad y(j), a_{Y(j)}, b_{Y(j)} \in \Re, \quad j = 1,\ldots,o$$
$$y(1) = \varphi(1)(x(1),\ldots,x(n))$$
$$\vdots$$
$$y(o) = \varphi(o)(x(1),\ldots,x(n))$$

Source: Own equation.

where Ξ is a set of factors that determines the potential of farm households to diversify into various non-farm income activities (Y). Ξ comprises n input variables (ξ(i), i=1,…, n). x(i) is an observed value for the input variable ξ(i). Y is a set of output variables (υ(j), j=1,…, o) and y(j) is the output value for the output variable υ(j). X(i) and Y(j) are the co-domains for ξ(i) and υ(j). The task is to define the control functions (φ(j)) that calculate for each tuple of input values the farm households' potential for diversification into various non-farm income activities y(j).

The model that is presented in this contribution does not distinguish between various non-farm income activities, thus having only one output variable, i.e., the farm households' potential to diversify into non-farm income activities while Ξ contains ten input variables. According to the theory of income diversification (Sections 2.2 and 3.2), the input variables can be summarised into the four factors: (i) need for diversification, (ii) internal conditions, (iii) external conditions, and (iv) attitudes towards employment alternatives. Therefore, the ten input variables will not directly be matched to the potential of income diversification but grouped into these four categories using linguistic intermediate variables γ(k) (k={necessity, internal, external, attitudes}) with values g(k). Thus, the model from Equation 4 is particularised in Equation 5:

Equation 5: Potential for non-farm income diversification of farm households

$$\Xi \rightarrow \upsilon(j), \qquad j = \{potential\}$$
$$\Xi = \{\gamma(necessity), \gamma(int\ ernal), \gamma(external), \gamma(attitudes)\}$$
$$y(potential) = \varphi(potential)\left(g(necessity), g(int\ ernal), g(external), g(attitudes)\right)$$

Source: Own equation.

Note: potential: household's potential for non-farm income diversification
necessity: need for diversification
internal: internal conditions
external: external conditions
attitudes: attitudes towards employment alternatives

The input variables are matched to the four intermediate variables according to Equation 6 to Equation 9.[7]

Equation 6: Need for diversification

$$\Gamma(necessity) \rightarrow \gamma(necessity)$$
$$\Gamma(necessity) = \{\xi(dep\_ratio), \xi(farm\_size)\}$$
$$g(necessity) = \varphi(necessity)\left(x(dep\_ratio), x(farm\_size)\right)$$

Source: Own equation.

Note: necessity: need for diversification
dep_ratio: dependency ratio
farm_size: farm size

[7] All input variables are described in Chapter 4.

Equation 7: Internal conditions

$$\Gamma(internal) \rightarrow \gamma(internal)$$
$$\Gamma(internal) = \{\xi(age), \xi(education), \xi(lab\_cap)\}$$
$$g(internal) = \varphi(internal)(x(age), x(education), x(lab\_cap))$$

Source: Own equation.

Note: internal: internal conditions
age: age
education: education
lab_cap: household's labour capacity

Equation 8: External conditions

$$\Gamma(external) \rightarrow \gamma(external)$$
$$\Gamma(external) = \{\xi(remoteness), \xi(lab\_market), \xi(purcha\,sing)\}$$
$$g(external) = \varphi(external)(x(remoteness), x(lab\_market), x(purcha\,sing))$$

Source: Own equation.

Note: external: external conditions
remoteness: remoteness
lab_market: labour market conditions
purchasing: regional purchasing power

Equation 9: Attitudes towards employment alternatives

$$\Gamma(attitudes) \rightarrow \gamma(attitudes)$$
$$\Gamma(attitudes) = \{\xi(self\_att), \xi(wage\_att)\}$$
$$g(attitudes) = \varphi(attitudes)(x(self\_att), x(wage\_att))$$

Source: Own equation.

Note: attitudes: attitudes towards employment alternatives
self_att: attitudes towards self-employed income activities
wage_att: attitudes towards wage employment

All ten input variables are considered to be fuzzy variables and are transformed in the fuzzification step into linguistic variables. Each linguistic input variable is characterised by a quintuple (i, n(i), T(i), X(i), M(i)), where i is the name of the variable, n(i) is the number of fuzzy subsets, T(i) is the set of linguistic terms for the fuzzy subsets, X(i) is the co-domain, and M(i) is the set of membership functions. The respective information is stored in the knowledge base.

3.3.2 Knowledge base

The knowledge base is at the core of a fuzzy inference system. It includes for each variable its name, the co-domain, the number of fuzzy subsets, a linguistic term and the membership function for each fuzzy subset, and the control functions. The membership functions are Z-shaped for the first fuzzy subset (Equation 10), S-shaped for the last fuzzy subset (Equation 11), and triangular for all other fuzzy subsets of a fuzzy input variable (Equation 12).

Equation 10: Z-shaped membership function

$$\mu_{\tau(i)}(x(i)) = \begin{cases} 1, & x(i) \le q, \\ \dfrac{r - x(i)}{r - q}, & q < x(i) < r, \\ 0, & r \le x(i) \end{cases} \qquad \mu_{\tau(i)}(x(i)) \in [0,1], \quad q, r, x(i) \in X(i), q < r$$

Source: Own equation.

Note: τ(i): name of a fuzzy subset of the input variable
q and r: definition points

Equation 11: S-shaped membership function

$$\mu_{\tau(i)}(x(i)) = \begin{cases} 0, & x(i) \le q, \\ \dfrac{x(i) - q}{r - q}, & q < x(i) < r, \\ 1, & r \le x(i) \end{cases} \qquad \mu_{\tau(i)}(x(i)) \in [0,1], \quad q, r, x(i) \in X(i), q < r$$

Source: Own equation.

Note: τ(i): name of a fuzzy subset of the input variable
q and r: definition points

Equation 12: Triangular membership function

$$\mu_{\tau(i)}(x(i)) = \begin{cases} \dfrac{x(i)-q}{r-q}, & q \le x(i) < r, \\ 1, & x = r, \\ \dfrac{s-x(i)}{s-r}, & r < x(i) \le s, \\ 0, & otherwise \end{cases} \qquad \mu_{\tau(i)}(x(i)) \in [0,1], \quad q, r, s, x(i) \in X(i), q < r < s$$

Source: Own equation.

Note: τ(i): name of a fuzzy subset of the input variable
q, r, and s: definition points

Table 3 summarises basic information for the ten input variables.

Table 3: Name, unit, co-domain, number of fuzzy subsets, linguistic terms, and definition points for membership functions for fuzzy input variables

i	Unit*)	$a_{X(i)}$	$b_{X(i)}$	n(i)	T(i)	Definition points r, q or r, q, s for membership function
age	years	0	100	5	very young	20, 30
					young	20, 30, 40
					middle	30, 40, 50
					old	40, 50, 60
					very old	50, 60
dep_ratio	ratio	0	7	3	low	0.5, 1.25
					average	0.5, 1.25, 2.0
					high	1.25, 2.0
education	scale	1	5	2	insufficient	2, 4
					sufficient	2, 4
farm_size	hectare	0	4,000	3	small	2, 7
					average	2, 7, 12
					large	7, 12
lab_cap	person equivalent	0	11	3	low	0.5, 1.0
					medium	0.5, 1.0, 2.0
					high	1.0, 2.0
lab_market	scale	1	5	2	unfavourable	2, 4
					favourable	2, 4
purchasing	percent	0	200	2	low	50, 100
					high	50, 100
remoteness	km	0	200	5	very low	20, 30
					low	20, 30, 40
					average	30, 40, 50
					high	40, 50, 120
					very high	50, 120
self_att	scale	1	5	2	negative	2, 4
					positive	2, 4
wage_att	scale	1	5	2	negative	2, 4
					positive	2, 4

Source: Own table.

Note: *) A detailed description of the variables is given in Chapter 4.

The sets T(k) with the linguistic terms for the four intermediate variables are given in Equation 13.

Equation 13: Linguistic terms for intermediate variables

$$T(\textit{necessity}) = \{\textit{unnecessary}, \textit{necessary}\},$$
$$T(\textit{int ernal}) = \{\textit{low}, \textit{medium}, \textit{high}\},$$
$$T(\textit{external}) = \{\textit{low}, \textit{medium}, \textit{high}\},$$
$$T(\textit{attitudes}) = \{\textit{negative}, \textit{positive}\}$$

Source: Own equation.

Note: necessity: need for diversification
internal: internal conditions
external: external conditions
attitudes: attitudes towards employment alternatives

The characteristics of the output variable "potential" are given in Table 4. Defuzzification is done by centre of maximum (CoM) method.

Table 4: Name, unit, co-domain, number of fuzzy subsets, linguistic terms, and definition points for membership functions for output variable

j	Unit	$a_{Y(j)}$	$b_{Y(j)}$	n(j)	T(j)	Definition points r, q for membership function*)
potential	index	0	1	2	low	0.3, 0.7
					high	0.3, 0.7

Source: Own table.

Note: *) The membership functions are defined according to Equation 10 and Equation 11 where τ(i), x(i), and X(i) are replaced by τ(j), y(j), and Y(j).

The model behaviour is driven by five control functions. Each control function is implemented as a block of linguistic rules as listed in Table 5 to Table 9. The rules reflect the rationale of non-farm income diversification as described in Sections 2.2 and 3.2 supplemented by the project team's expert knowledge.

Table 5: Rules for the potential for non-farm income diversification of farm households

IF **necessity** IS	AND **internal** IS	AND **external** IS	AND **attitudes** IS	THEN **potential** IS
unnecessary	low	low	negative	low
unnecessary	low	low	positive	low
unnecessary	low	medium	negative	low
unnecessary	low	medium	positive	low
unnecessary	low	high	negative	low
unnecessary	low	high	positive	low
unnecessary	medium	low	negative	low
unnecessary	medium	low	positive	low
unnecessary	medium	medium	negative	low
unnecessary	medium	medium	positive	high
unnecessary	medium	high	negative	low
unnecessary	medium	high	positive	high
unnecessary	high	low	negative	low
unnecessary	high	low	positive	low
unnecessary	high	medium	negative	low
unnecessary	high	medium	positive	high
unnecessary	high	high	negative	low
unnecessary	high	high	positive	high
necessary	low	low	negative	low
necessary	low	low	positive	low
necessary	low	medium	negative	low
necessary	low	medium	positive	high
necessary	low	high	negative	low
necessary	low	high	positive	high
necessary	medium	low	negative	low
necessary	medium	low	positive	high
necessary	medium	medium	negative	low
necessary	medium	medium	positive	high
necessary	medium	high	negative	low
necessary	medium	high	positive	high
necessary	high	low	negative	low
necessary	high	low	positive	high
necessary	high	medium	negative	low
necessary	high	medium	positive	high
necessary	high	high	negative	low
necessary	high	high	positive	high

Source: Own table.

Note: potential: household's potential for non-farm income diversification
necessity: need for diversification
internal: internal conditions
external: external conditions
attitudes: attitudes towards employment alternatives

Table 6: Rules for the need for diversification

IF **dep_ratio** IS	AND **farm_size** IS	THEN **necessity** IS
low	small	necessary
low	average	unnecessary
low	large	unnecessary
average	small	necessary
average	average	necessary
average	large	unnecessary
high	small	necessary
high	average	necessary
high	large	necessary

Source: Own table.

Note: necessity: need for diversification
dep_ratio: dependency ratio
farm_size: farm size

Table 7: Rules for the internal conditions

IF **age** IS	AND **education** IS	AND **lab_cap** IS	THEN **internal** IS
Very young	insufficient	low	low
Very young	insufficient	medium	low
Very young	insufficient	high	low
Very young	sufficient	low	low
Very young	sufficient	medium	low
Very young	sufficient	high	low
young	insufficient	low	low
young	insufficient	medium	low
young	insufficient	high	low
young	sufficient	low	low
young	sufficient	medium	medium
young	sufficient	high	high
middle	insufficient	low	low
middle	insufficient	medium	low
middle	insufficient	high	low
middle	sufficient	low	low
middle	sufficient	medium	medium
middle	sufficient	high	high
Old	insufficient	low	low
Old	insufficient	medium	low
Old	insufficient	high	low
Old	sufficient	low	low
Old	sufficient	medium	medium
Old	sufficient	high	high
Very old	insufficient	low	low
Very old	insufficient	medium	low
Very old	insufficient	high	low
Very old	sufficient	low	low
Very old	sufficient	medium	low
Very old	sufficient	high	low

Source: Own table.

Note: internal: internal conditions
age: age
education: education
lab_cap: household's labour capacity

Table 8: Rules for the external conditions

IF **remoteness** IS	AND **lab_market** IS	AND **purchasing** IS	THEN **external** IS
Very low	unfavourable	low	low
Very low	favourable	low	medium
Very low	unfavourable	high	medium
Very low	favourable	high	high
Low	unfavourable	low	low
Low	favourable	low	medium
Low	unfavourable	high	medium
Low	favourable	high	high
average	unfavourable	low	low
average	favourable	low	medium
average	unfavourable	high	medium
average	favourable	high	high
High	unfavourable	low	low
High	favourable	low	low
High	unfavourable	high	low
High	favourable	high	medium
Very high	unfavourable	low	low
Very high	favourable	low	low
Very high	unfavourable	high	low
Very high	favourable	high	low

Source: Own table.

Note: external: external conditions
remoteness: remoteness
lab_market: labour market conditions
purchasing: regional purchasing power

Table 9: Rules for attitudes towards employment alternatives

IF **wage_att** IS	AND **self_att** IS	THEN **attitudes** IS
negative	negative	negative
negative	positive	positive
positive	negative	positive
positive	positive	positive

Source: Own equation.

Note: attitudes: attitudes towards employment alternatives
self_att: attitudes towards self-employed income activities
wage_att: attitudes towards wage employment

4 SIMULATION DATA

SCARLED provided micro data of 1,077 rural households in Bulgaria, Hungary, Poland, Romania, and Slovenia. A detailed description of the sampling method is given in deliverable D2.1 (Buchenrieder et al. 2007). A main survey collected micro data of rural farm households while a second one covered the village level. The survey data refer to year 2006. Additionally, data from Eurostat's online database supplemented the modelling database for regional information.

For the rural farm household survey, regions and villages were selected through a two-stage clustered sampling process. As a first step, three regions in each country were selected according to their degree of economic development: (1) lagging behind, (2) average and (3) prosperous, corresponding to a GDP per capita below, average and higher than the national average.

In the second stage, three villages per NUTS 3[8] region were selected again with a view to cover the variations within NUTS 3 regions, namely a prosperous, average and lagging behind village in comparison to the regional average. As pointed out by Deaton (1997), this sampling design of first selecting clusters and then farms/households, has many advantages. First, it is very cost-effective since survey teams only will have to visit a few locations instead of visiting households dispersed all over a country. Second, clustered samples like this one also facilitate repeated visits. Third, clustered sampling serves very well investigations of pre-defined target groups, as in this case rural farm households. For these reasons, clustered sample surveys have been widely used in developing country contexts. Similar selection procedures have been applied by Mathijs and Noev (2002), Möllers (2006), and Petrovici and Gorton (2005).

Only households with agricultural activities including gardens or yards belonging to the house in two time points, i.e. the year 2006 as the most recent year and 2003 as the last year before the accession of Poland, Hungary, and Slovenia to the EU, were included in the sample. Whether a household participated in, or was excluded from the survey, was determined by an entry question so that only households with agricultural production in either one or both reference points are included in the SCARLED survey.

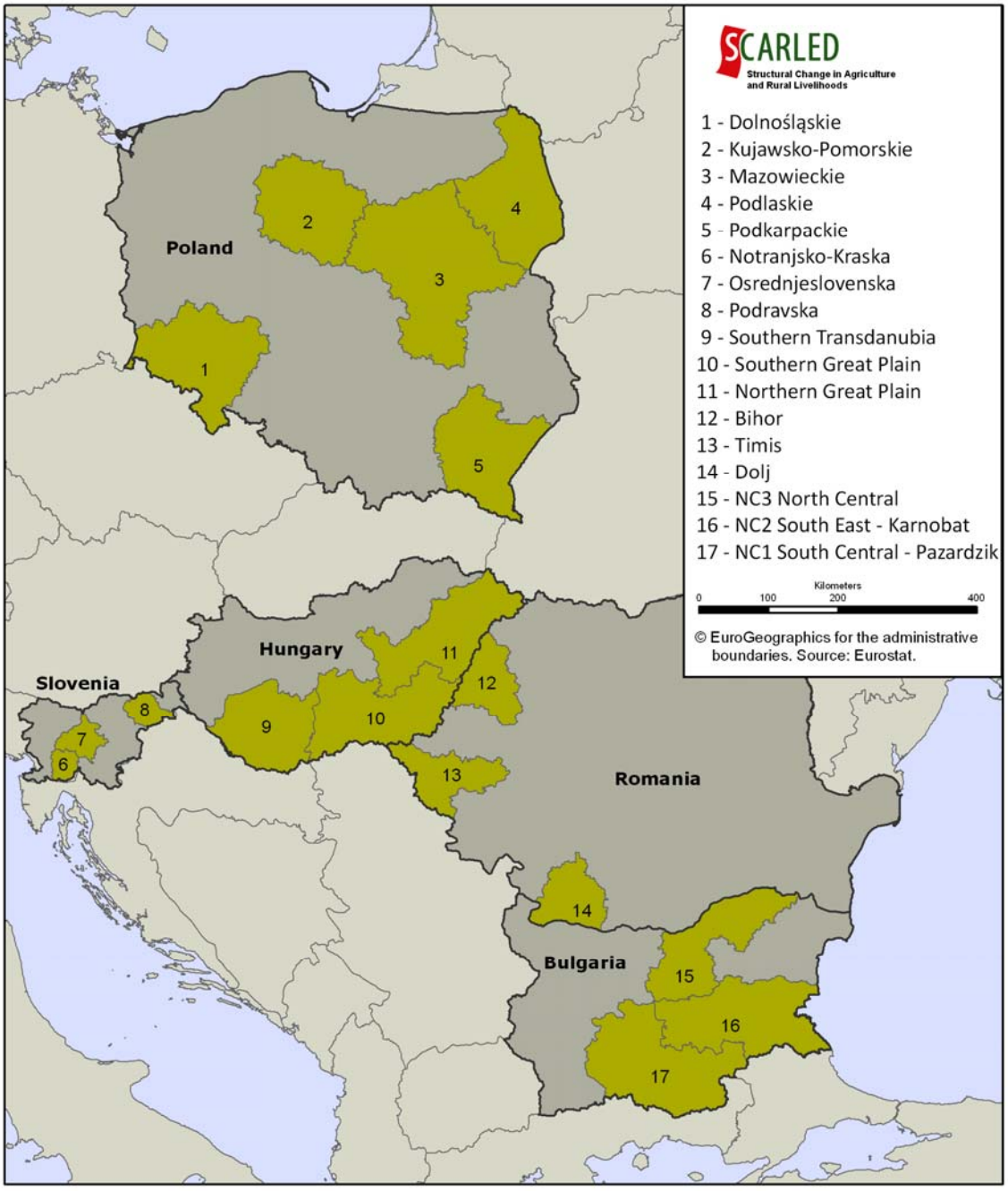
The target sample size for each country was approximately 300 observations, i.e. 30-35 observations per village. When this target could not be reached, the survey was extended to four villages per NUTS 3 region lowering the number of household observations per village to 25. Map 1 shows the NUTS 3 regions included in the multi-country survey of SCARLED. The person interviewed in the household was preferably the household head, as this is the person who is assumed to know most about the household and also has the greatest influence regarding decision making within the household, especially as regards the orientation and diversification of household and farming activity.

In each selected village, a separate questionnaire was answered by a village representative. The aim of this questionnaire was to provide a picture of key village

[8] "The Nomenclature of Territorial Units for Statistics (NUTS) was established by Eurostat more than 30 years ago in order to provide a single uniform breakdown of territorial units for the production of regional statistics for the European Union." (Eurostat 2010a). It has six levels, NUTS 0 stands for the country, NUTS 1 to NUTS 3 are regional levels, and NUTS 4 and NUTS 5 are local levels. NUTS 3 is the smallest regional level with all NUTS 3 regions are subdivisions of their respective NUTS 2 region.

characteristics such as physical and market infrastructure, services, and factor market characteristics.

Map 1: NUTS 3 survey regions in the five SCARLED survey countries



Source: Own map.

The final sample of rural farm households contains 1,349 valid households of which 114 households stopped farming between 2003 and 2006. For another 272 households, the database was incomplete thus the diversification potential of rural farm households was calculated using 1,077 households (Table 10).

Table 10: Number of households

Country	Number of surveyed households	Number of households that stopped farming between 2003 and 2006	Number of households with missing values for model variables	Number of valid households for simulation
Bulgaria	271	36	48	223
Hungary	280	20	62	218
Poland	270	25	71	199
Romania	269	4	45	224
Slovenia	259	29	46	213
Total	1,349	114	272	1,077

Source: Own calculations with data from SCARLED survey.

The dependency ratio (*dep_ratio*) was measured as the share of persons older than 64 years and younger than 20 years as a proportion of the household members between 20-64 years old (economically active age).[9] Households without economically active members, i.e. pensioner households, were assigned the value 3.0 to keep them in the sample. The median dependency ratio is lowest in Hungary (0.25) and highest in Slovenia (0.67). In all surveyed countries, households with no dependent members and pensioner households were involved in the survey thus all countries cover the range from 0.0 to 3.0 for the dependency ratio. Detailed tables with descriptive statistics for each survey country are provided in the Annex from Table A 1 to Table A 27.

The farm size (*farm_size*) was measured in total available area of agricultural land, which includes permanently fallow land. The median farm size ranges between 2.61 ha in Bulgaria and 8 ha in Slovenia. Notwithstanding that the farms in the sample were rather small, also households operating large-scaled agricultural enterprises were involved. The largest farms were reported for Bulgaria (3,800 ha), Romania (350 ha), and Hungary (335 ha).[10]

The age of the household members (*age*) and its effect on diversification required particular attention. Common sense requires a figure that excludes household members that are not of an economically active age. Thus, for households with members in the economically active age, the average household age was calculated excluding children younger than 20 years and pensioners older than 64 years. For households consisting

[9] The authors follow with this the definition the view of EC (2009).

[10] In non-fuzzy econometrical models, those households would be outliers and had to be excluded from analysis. Keeping them in the sample could affect results in two directions. They could determine the model results when being significant or they could increase the model error so that there will be no significant variable at all. Fuzzy inference systems are insensitive to outliers, i.e. in the fuzzification step the farms are labelled "large" (Table 3).

exclusively of pensioners, their average age was entered in the model. The median age is between 41 years in Poland and Slovenia and 46 years in Romania. In each survey country, very "young" and very "old households" are part of the sample. The youngest household was interviewed in Bulgaria (22 years) and the oldest in Hungary (91 years).

Education (*education*) refers to the highest level of education that a household member has attained. The median educational level is 'finished middle school' in Hungary and Slovenia and 'finished high school' in the other three countries. More than one fifth of Bulgarian and Romanian households have at least one member with a university degree whereas in Poland no household member with a university degree was reported. Households without formal schooling were only interviewed in Bulgaria (three households).

Labour capacity (*lab_cap*) was measured in person equivalents that is the sum of all household members of an economically active age plus the number of pensioners up to 69 years old multiplied with 0.5 plus the number of pensioners between 70 and 74 years old multiplied with 0.25 to account for their reduced but still existent labour capacity.[11] Median labour capacity ranges from two person equivalents in Bulgaria, Hungary, and Romania to three person equivalents in Slovenia. In all countries, households without labour capacity were observed but there are also ones with plenty of available labour, i.e. the maximum observed labour capacity was between six person equivalents in Hungary and Romania and eight person equivalents in Poland.

The remoteness (*remoteness*) of the villages was measured as the distance in kilometres to the next large urban centre. This information was taken from the village questionnaire. Households are located differently remote in the countries. The widest ranges were observed in Poland (8-75 km) and Bulgaria (10-78 km) while Slovenian households have only 4-22 km to the next large urban centre. Hungarian (8-33 km) and Romanian households (10-30 km) are in between.

Household members older than 19 years were asked for an assessment of the local labour market (*lab_market*). The question was how they rated their chance of finding a job on the local labour market. For each household, the maximum rating of all answers was entered in the calculation. With the exception of Slovenia, households assess the labour market situation in their region rather pessimistic. While in Slovenia nearly half of the households see good chances[12] of finding a job, the picture reverses in the other countries in which one third of households in Poland to more than half of the households in Romania rate their chances of finding a job rather bad[13].

The regional (NUTS 3 regions) purchasing power (*purchasing*) was measured relative to the country average. Figures were taken from Eurostat (2009) and refer to the year 2006. Sampling methodology predetermined this variable by selecting survey regions according to their degree of economic development: (1) lagging behind, (2) average, and (3) prosperous, corresponding to a GDP per capita below, average, and higher than the national average. Thus, values for this variable range between approximately 70-160% of national purchasing power for the households in Poland, Romania, and Slovenia. In Bulgaria, the range is narrower with approximately 70-100% of national purchasing power

[11] Harsche (2007) stresses that due to limited income alternatives, elderly household members operate the farm thus increasing household labour capacity.

[12] This refers to the sum of the figures for the categories "good" and "very good".

[13] This refers to the sum of the figures for the categories "bad" and "very bad".

while regional differences in economic development are not well represented in the Hungarian survey sample. Hungarian households are located in regions with purchasing power of approximately 60-70% of national average.

The attitudes towards wage employment (*wage_att*) and self-employment (*self_att*) were assessed among all household members older than 19 years and the maximum rating was included in the model. In general, households have more positive attitudes towards waged jobs than towards self-employed activities. Nevertheless, country specific differences for wage and self-employment can be observed. The share of households having positive attitudes[14] towards wage employment ranges between 66% in Hungary and 79% in Bulgaria while negative[15] attitudes show only 3% of Polish up to 14% of Romanian households. Fifty-four percent of Bulgarian households report a positive attitude towards self-employment but this share decreases to 22% of households in Poland. Negative attitudes towards self-employment were reported by 27% of households in Bulgaria coming up to 33% of households in Romania.

[14] This refers to the sum of the figures in the categories "somewhat positive" and "very positive".
[15] This refers to the sum of the figures in the categories "somewhat negative" and "very negative".

5 SIMULATION RESULTS AND QUALITY ASSURANCE OF MODEL

This chapter presents the simulation results (Section 5.1). It also assesses the quality of the model by verifying and validating the results. For validation, simulated non-farm diversification potential is compared with actually observed diversification behaviour (Section 5.2). This results in four technical groups of households with different diversification potential and behaviour (Section 5.3). From these four groups, six types of households are derived that can be distinguished in terms of their need for diversification, internal and external conditions, attitudes towards employment alternatives, and actual diversification behaviour (Section 5.4). Verification is done by calculating regression models to test whether the theoretical assumptions are correctly implemented in the knowledge base of the fuzzy logic model (Section 5.5).

5.1 Simulation results

Simulation results for 1,077 farm households (Table 11) show that three quarters of households (76.2%) have the potential to diversify their income activities into non-farm rural employment. The used threshold value is 0.5; all households that have a simulated potential for non-farm income diversification of at least 0.5 have the potential to diversify their income activities. The results for the individual countries show that there are significant country specific differences in this potential that range from 62% for Hungarian households to 88% for Slovenian households[16].

Table 11: Number and percentage of households with a non-farm diversification potential

Country	Number of simulated households	Households with a non-farm diversification potential	
		N	%
Bulgaria	223	146	65.5
Hungary	218	135	61.9
Poland	199	163	81.9
Romania	224	190	84.8
Slovenia	213	187	87.8
Total	1,077	821	76.2

Source: Own calculations with data from SCARLED survey.

The model separates the households with a diversification potential significantly from those with no potential (Table 12 and Table A 28 to Table A 32 in the Annex). All ten variables contribute to the separation although country specific differences in the composition of the set of significant variables can be observed. The dependency ratio is not significant in Poland and Slovenia. Education is not significant in Bulgaria. Remoteness does not separate the households in Hungary, Romania, and Slovenia. The regional purchasing power plays no role in Bulgaria, Hungary, and Slovenia.

[16] The surveys did not collect data that is representative for the agricultural sector. Thus, generalisations for the sector should be done with caution.

Table 12: Significant differences between households with and without a potential for non-farm activities

Variable	Bulgaria	Hungary	Poland	Romania	Slovenia
Dependency ratio	**	*		***	
Farm size	***	**	***	*	***
Age	***	***	***	***	**
Education		***	***	***	***
Labour capacity	***	***	***	***	**
Remoteness	***		***		
Labour market	***	***	**	***	***
Purchasing power			*	***	
Attitudes towards wage employment	***	***	***	***	***
Attitudes towards self-employment	***	**	*	***	***

Source: Own calculations with data from SCARLED survey.

Notes: Significance levels of Mann-Whitney test: * 10%, ** 5%, and *** 1%.
Detailed results are in Table A 28 to Table A 32 in the Annex.

The model provides good results. Nevertheless, two points of quality assurance, i.e. validation and verification of the model deserve attention (Balzert 1998, Sommerville 2007). A model is valid when it meets the objectives of the modeller. In this study, the question whether the simulated diversification potential is congruent to the existing one, refers to model's validity. Additionally, verification aims at the theoretical correctness of the implemented algorithms. It answers the question whether the behaviour of the model pictures right the implemented theory of rural non-farm income diversification. The first question is difficult to answer because the effective household potential cannot be observed. Interpretation of the characteristics of households with a diversification potential in comparison to households without this potential reflects the theory that was implemented in the model but not the real diversification potential. However, it can be assumed that households tend to use their existing potential for income generation. Therefore, it is analysed whether the households with a simulated potential to diversify are actually diversified and whether diversified households are rated by the model as potential diversifiers (Section 5.2 to 5.4). The second question is answered by calculating a linear regression with model variables as independent and the simulated potential to diversify as dependent variable (Section 5.5).

5.2 Comparison of modelled non-farm diversification potential with observed households' behaviour

Table 13 shows the number and the percentage of actually diversified households. Comparing the figures with those from Table 11 shows that the model in general sees for more households a diversification potential (76.2%) than are actually diversified (67.1%). Although there is a good consistency for Bulgaria (65.5% to 62.8%) and Hungary (61.9% to 66.1%), the discrepancy is relatively high for Poland (81.9% to 62.8%) and Romania (84.8% to 66.5%).

Table 13: Number and percentage of actually diversified households

Country	Number of simulated households	Diversified households	
		N	%
Bulgaria	223	140	62.8
Hungary	218	144	66.1
Poland	199	125	62.8
Romania	224	149	66.5
Slovenia	213	165	77.5
Total	1,077	723	67.1

Source: Own calculations with data from SCARLED survey.

At first glance, this seems to be a disappointing result. But a second glance at the share of correctly classified households (Table 14) shows that for three quarters of households (74.2%) the simulated potential for non-farm diversification is congruent to the observed household behaviour. Thus, households use their existing potential and households rated as having no diversification potential are indeed not diversified.

Table 14: Number and percentage of correctly classified[1)] households

Country	Number of correctly classified households	Number of correctly classified households with no diversification potential	Number of correctly classified households with a diversification potential	Percent of correctly classified households
Bulgaria	155	46	109	69.5
Hungary	163	51	112	74.8
Poland	141	26	115	70.9
Romania	177	31	146	79.0
Slovenia	163	12	151	76.5
Total	799	166	633	74.2

Source: Own calculations with data from SCARLED survey.

Note: [1)] Households that are not actually diversified and were classified as households with no non-farm diversification potential and households that are actually diversified and were classified as households with a non-farm diversification potential are called correctly classified households.

For the remaining quarter of households (25.8%, Table 15), the observed behaviour diverges from the simulated non-farm diversification potential. These households could be considered as incorrectly classified. It is argued, however, that nonetheless they allow for interesting insights in the complex system of non-farm income diversification. Therefore, all four groups will be described in the following.

Table 15: Number and percentage of diverging classified[1)] households

Country	Number of diverging classified households	Number of households with a diversification potential that are not diversified	Number of households with no diversification potential that are diversified	Percent of diverging classified households
Bulgaria	68	37	31	30.5
Hungary	55	23	32	25.2
Poland	58	48	10	29.1
Romania	47	44	3	21.0
Slovenia	50	36	14	23.5
Total	278	188	90	25.8

Source: Own calculations with data from SCARLED survey.

Note: [1)] Households that are not diversified although they have a diversification potential and households that are diversified although not having the potential are called diverging classified households.

5.3 Description of identified groups of households[17]

The model results are compared to the actually observed diversification behaviour. The cross tabulation of simulated diversification potential and observed diversification behaviour reveals four groups of households in the sample: (i) actually diversified households with a diversification potential, (ii) not diversified households with no diversification potential, (iii) actually diversified households with no diversification potential, and (iv) not diversified households with a diversification potential. In the following, these four groups of households are described. Description starts with the ten input variables and continues with intermediate variables of the model. Detailed descriptive statistics for input variables and model results for the four groups by countries are given in Table A 33 to Table A 40 in the Annex. These four groups are artificial in the sense that they are generated by combining two binary variables to a contingency table. This technical procedure is complemented by empirical results in Section 5.4.

Characteristics of actually diversified households with a diversification potential

The majority of households (58.8%, 633 households) has a potential for diversification and is de facto diversified. In this group, households cultivate only small farms with up to 4 ha. An exception is Slovenia where farms in this group are larger than 7 ha. The dependency ratio is low in all five countries and does not exceed 0.5. The average age of adult household members is quite low with up to 42 years. The educational level is rather high. The households have members who have finished middle or high school. All households possess of sufficient labour capacity (2.25 person equivalents in Romania and 3 person equivalents in all other countries). The households are located relatively close to urban centres; the distance to the next large urban centre is only up to 18 km. An exception is Bulgaria where the next large urban centre is 42 km away. The chances on the labour

[17] The figures given for the model input and intermediate variables as well as the model output refer to the median values for the survey countries. Thus, statements are made for the majority of households regardless the fact that single households could deviate remarkably from the median household.

market are rated as neither bad nor good. In Hungary the chances are slightly better and in Slovenia household members believe that they have good chances of finding a job. Regional purchasing power reflects the average country level in Romania and is below the country average in all other countries. Attitudes towards wage employment are positive while they are slightly less positive towards self-employment (Table A 33).

Looking at model results for the intermediate variables and households' potential for non-farm income diversification shows that actually diversified households with a diversification potential face in general a considerable need for diversification[18]. Slovenian households are an exception from this rule because for them the need for diversification is low. In all countries, internal conditions show high values[19]; external conditions show medium or high values[20]. Attitudes towards employment alternatives are positive (Table A 34).

Actually diversified households with diversification potential have the characteristics that are theoretically expected (Section 2.2). An exception is the low pressure to diversify of Slovenian households (farm size=7.13 ha, dependency ratio=0.5). In this case, the exceptional good external conditions (remoteness=15 km, good chances on the labour market) form a demand-pull environment under which the households diversify irrespective from pressure and under rather ambiguous internal conditions (age=39 years, middle school, labour capacity=3.0 person equivalents).

[18] The need for diversification indicates the pressure which the household faces to earn additional income. The pressure is the higher the smaller the farm is, and the higher the dependency ratio in the household is (for the rules see Table 6).

[19] Internal conditions get higher values and are thus more favourable, the more favourable the age is, and the higher the qualification level and the labour capacity in the household are (for the rules see Table 7).

[20] External conditions are the higher the less remote a household is located, the more favourable the local labour market and the better developed the rural region are (for the rules see Table 8).

Characteristics of not diversified households with no diversification potential

A small share of households (15.4%, 166 households) are not diversified and the model shows no diversification potential for them.

The farms in this category are small in Bulgaria (4.6 ha) and Romania (3.4 ha) and remarkably larger in the other three countries (≥8 ha). The dependency ratio varies between 0.5 in Poland and 3.0 in Romania. The average age of adult household members is high with at least 60 year. An exception is Poland where average age is only 49 years. The educational level varies between primary school in Poland and high school in Bulgaria. Also the labour capacity differs between the countries. It is 0.5 person equivalents in Romania and reaches 2.0 person equivalents in Poland. With the exception of Bulgaria, households have less than 20 km to the next large urban centre while this distance is 58 km for Bulgarian households. The chances on the labour market are rated as bad and very bad. Only in Slovenia, there is a slight tendency to neither bad nor good chances on the local labour market. The regional purchasing power is low for all five countries and ranges between 66.3% in Hungary and 84.4% in Slovenia. Attitudes towards wage employment or self-employed activities are very negative in Romania, negative with a slight tendency to indifferent in Slovenia and indifferent in Hungary and Poland. Only in Bulgaria, households have positive attitudes towards wage employment while their attitudes towards self-employment are only indifferent (Table A 35).

Model results show that Bulgarian, Hungarian, and Romanian households are under need for diversification. For Polish and Slovenian households, this need is lower. The internal conditions are not favourable and the external conditions are also on a low or medium level in all five countries. Attitudes are negative in Romania and Slovenia, ambiguous in Hungary and Poland, and positive in Bulgaria (Table A 36).

The results are concordant with theory. Despite the diversification pressure, Bulgarian, Hungarian, and Romanian households cannot embark on non-farm rural employment due to their adverse internal and external conditions. Polish and Slovenian households are generally under no pressure to diversify thus unmet internal and external conditions do not really act as constraints.

Characteristics of actually diversified households with no diversification potential

Very few households (8.4%, 90 households) are diversified although the model labels them as having no diversification potential.

The households in this category operate farms between 10 and 15 ha. An exception is Romania where the farms are significantly smaller with only 5.1 ha. The dependency ratio is low. Hungarian, Polish, and Romanian households do not have dependent household members at all while in Bulgaria dependency ratio is 0.5 and in Slovenia 1.0 respectively. With the exception of Slovenia, the average age of adult household members is quite high. The age ranges between 46 years in Bulgaria and 57 years in Romania. In Slovenia it is only 42 years. The educational level is high in Bulgarian, Romanian, and Polish households (high school) while it is lower in Hungarian households (middle school) and slightly lower in Slovenian households (between finished primary and middle school). Labour capacity is high and exceeds 2 person equivalents in Poland (2.3 person equivalents) and Slovenia (2.6 person equivalents). Hungarian, Romanian, and Slovenian households have less than 20 km to the next large urban centre while Bulgarian and Polish households are situated in remote regions with at least 60 km to the next large urban centre. The chances on the labour market are rated bad and very bad. Only in Poland the chances of finding a job are rated as neither bad nor good. The regional purchasing power is with the exception of Romania below the respective country's average. The attitudes towards wage employment are positive and very positive. Only Slovenian households have indifferent attitudes towards wage employment. The attitudes towards self-employment are indifferent and in Slovenia even negative (Table A 37).

For all five countries, the model concludes that households in this group are not under need for diversification and that external conditions are low or in the best case on a medium level. Internal conditions are mainly high in Bulgaria, Hungary, and Poland but low in Romania and Slovenia. However, attitudes towards employment alternatives are mainly positive (Table A 38).

At the first glance, these results seem to be odd in the light of the theory of non-farm diversification (Section 2.2). Nevertheless they are plausible when considering that income diversification could have started many years ago and that a household could have lost its potential since then without losing the actual employment. Two variables - age and chances of finding a job on the labour market - are crucial in this context. The average age of the adult household members is between 42 (Slovenia) and 57 years (Romania) and the chances on the labour market are rated between very bad (Hungary) and neither bad nor good (Poland). Thus the conclusion is that the households had a much higher diversification potential some years ago and, back then, used this potential. Over time the variables describing the diversification potential changed, but the employment decisions taken at an earlier stage are still reflected in the actual engagement in non-farm income activities.

Characteristics of actually not diversified households with a diversification potential

Less than one fifth of households (17.4%, 188 households) have a modelled diversification potential but do not use it.

Bulgarian, Hungarian, and Romanian households in this category operate small farms ranging between 1.2 ha in Bulgaria and 4 ha in Romania. The farms are larger in Slovenia (7.3 ha) and Poland (9.8 ha). The dependency ratio varies between 0.0 in Hungary and 2.0 in Slovenia. The average age of adult household members are for the Bulgarian, Hungarian, and Polish households quite low (41-43 years) while it is remarkably higher in the Slovenian and Romanian households (50-55 years). Education is mainly on an average level with middle school in Hungary, Romania, and Slovenia and better in Bulgaria and Poland (high school). Labour capacity ranges between 1.4 person equivalents in Slovenia and 2.0 person equivalents in Bulgaria, Hungary, and Poland. With the exception of Bulgaria, households have less than 20 km to the next large urban centre. In Bulgaria, it is 45 km. The chances on the labour market are rated as very bad (Romania), bad (Poland), and neither bad nor good in the other three countries. The regional purchasing power reflects the country's average in Poland (107%) and Romania (99.6%); it is above the national average in Slovenia (144.2%), and below the national average in Bulgaria (80%) and Hungary (66.3%). Attitudes towards wage employment are in general positive and even very positive in Bulgaria. Towards self-employment, the attitudes are less positive (Table A 39).

Model results do not give a clear picture for households in this category. Diversification is necessary except for the Polish households and attitudes towards employment alternatives are positive in all countries. Internal conditions are high for Bulgarian and Polish households but indifferent for the other ones. External conditions are in general on a medium level with broad distributions to the levels low and high (Table A 40).

It seems that the unclear picture evolves from the fact that this group involves households of different kind: (i) households may be on the verge of income diversification and a small incentive could encourage them to embark on diversification activities, (ii) some households especially the ones operating larger farms could refuse to embark on non-farm activities notwithstanding their generally good conditions, and (iii) few households may be misclassified. The simulated potential of 0.5 for Hungary and 0.54 for Romania indicates that country specific fine-tuning of the model is necessary. It seems further justified to assume that misclassification also happened because some households did not mention their non-farm employment thus causing a model's error that condenses in this group.

5.4 Identified types of households

The description of the four artificial groups of households in Section 5.3 is only of limited value because it does not give empirical evidence for the dynamics of structural change in rural areas. Nevertheless, their description showed that there can be empirical household types identified within the artificial groups. Figure 7 shows the allocation of the household types to the four household groups. Altogether, six household types are identified, which are distinguished according to the ten input and the four intermediate model variables:

a. Households acting under a demand-pull environment (**diversifiers by choice**[21]),
b. Households that still enjoy the benefits of a past demand-pull environment (**past diversifiers by choice**),
c. Non-diversified households with a strong focus on farming (**farmers**),
d. Distress-push diversifiers households (**diversifiers through necessity**),
e. Possible job-starters households (**job-starters**), and
f. Penioner households living under distress-push conditions (**pensioners**).

In the following, the six household types are described. For this, median values for the households of the respective types in one country are used. This median household is selected to show representative features of the respective type. Description starts with the ten input variables and continues with model's intermediate variables.

Figure 7: Allocation of the six household types to the four household groups

		Potential of non-farm diversification	
		Yes	No
Actually diversified	Yes	**Diversifiers by choice** (type a, N=151) **Diversifiers through necessity** (type d, N=482)	**Past diversifiers by choice** (type b, N=90)
	No	**Farmers** (type c, N=48) **Job-starters** (type e, N=140)	**Farmers** (type c, N=38) **Pensioners** (type f, N=128)

Source: Own figure.

[21] The authors follow the terminology by Ellis (2000) who distinguishes between diversification of necessity and diversification by choice.

a) Households acting under a demand-pull environment (diversifiers by choice, N=151**)**

Diversifiers by choice are farm households with a diversification potential that are actually diversified. Within the SCALED sample, this household type is only found in Slovenia.

Households operate medium-scaled farms (7.1 ha) and have a low dependency ratio (0.5) but a high labour capacity (3 person equivalents). The average age of adult household members is low (39 years) but the highest educated household members attended only middle school. Households are situated in regions with a purchasing power slightly below the country's average (84.4%), but are well connected to the next large urban centre (15 km). The chances of finding a job on the labour market are rated as good. Attitudes towards wage employment are positive but only indifferent towards self-employed activities (Table A 33).

The model shows that these households are under no need for diversification. The external conditions are favourable and the attitudes are positive. However, internal conditions show only a medium level (Table A 34).

b) Households that still enjoy the benefits of a past demand-pull environment (past diversifiers by choice, N=90**)**

All households in the group of actually diversified households with no diversification potential belong to this type. The Bulgarian median household is used to describe the characteristics of this household type.

The households dispose of a larger farm (15 ha). A low dependency ratio (0.5) together with a high labour capacity (2 person equivalents), high education (high school), and very positive attitudes towards wage employment are contributing to the potential for diversification. However, it is assumed that the decision for income diversification was made some time ago when the situation on the labour market was more favourable and the adult household members themselves were still younger. Back then diversification took place even in more remote regions (60 km to the next large urban centre). Now, the household members are older (46 years) and their chances on the labour market decreased. A comparably low regional purchasing power (71.3% of the national average) also indicates an unfavourable labour market (Table A 37).

Households are under no need for diversification in terms of their farm land and family structure. The internal conditions are still good and attitudes towards employment alternatives are positive. However, external conditions are problematic (Table A 38).

c) Non-diversified households with a strong focus on farming (farmers, N=86, of which 48 households with and 38 households without a potential for non-farm income diversification**)**

The main characteristic of this type is that households are not diversified. This is independent from their diversification potential thus this household type is found in two groups of households, i.e. the not diversified household with and without a diversification potential. Within the SCARLED sample, households of farmers' type are found in Poland and Slovenia only. This indicates that these households represent the social group of private family farmers that diminished in former socialist countries except in Poland and former Socialist Federal Republic of Yugoslavia.[22] As a farmers' household with diversification potential, the median Polish household is described. For households with no diversification potential, the median Slovenian household is taken as an example.

The Polish farmers **with diversification potential** operates a larger scaled farm (9.8 ha), adult household members are middle aged (43 years old), and well educated (high school). The labour capacity is high (2 person equivalents), but there is also a dependent household member for each economically active household member (dependency ratio 1.0). The households are located near the next large urban centre (8 km) in a well developed region (purchasing power 107%). Attitudes towards wage employment are positive however people rate their chances on the labour market as bad. Attitudes towards self-employment are indifferent (Table A 39).

The model summarises this to a medium need for diversification, favourable internal conditions and medium level external conditions. The attitudes towards employment alternatives are positive (Table A 40). This type of households does not use its potential. A strong commitment to agriculture may be the reason; this is often observed in Poland and deeply rooted in the country's traditions.

The Slovenian farmers with **no diversification potential** cultivate 12.5 ha. The dependency ratio is average (1.0) while the labour capacity is rather high (1.75 person equivalents). The higher average age of adult household members (60 years old) and the lower educational level (between finished primary and middle school) correspond well to the low chances on the labour market (bad with a tendency to neither bad nor good). Households are located near a large urban centre (16 km) in slightly less developed regions (84.4% purchasing power). The attitudes towards wage employment are bad and only slightly better towards self-employment (Table A 35).

The model concludes that the household is under no need for diversification. The internal conditions are low and the external ones are only on a medium level. Attitudes towards employment alternatives are negative (Table A 36). Focussing on agriculture seems straightforward for these households because they are experienced in this field and their potential to open up alternative income sources seems rather low.

[22] This result does not suggest that there are no private family farmers in the other surveyed countries but it reflects that this group is still not so well developed in Bulgaria, Hungary, and Romania. According to Eurostat (2010b), farms of size 8 to 40 ESU comprise for only 0.5% of holdings in Romania up to 3.7% in Hungary but for 9.5% in Poland and 15.4% in Slovenia.

d) Distress-push diversifier households (diversifiers through necessity, N=482**)**

Diversifiers through necessity are those households that have already diversified and display a potential to diversify. This household type was found in all survey countries except Slovenia. The median Polish household is used for characterising the type.

The typical diversifier through necessity in Poland operates a small farm (2.8 ha). The average age of adult household members and the dependency ratio are low (39 years old, dependency ratio=0.3) while the labour capacity (3 person equivalents) and the educational level (finished high school) are high. Attitudes towards wage employment are very positive but only indifferent towards self-employed activities. The household is located near a large urban centre (8 km) in a fairly developed region (87.4% purchasing power) (Table A 33).

The model concludes that the household faces a need for diversification. The internal conditions are high and the attitudes are positive. The external conditions are between medium and high (Table A 34). Households of this type found a strategy that allows them to sustain their livelihoods under constraint agricultural assets by employing their non-farm diversification potential.

e) Possible job-starter households (job-starters, N=140**)**

Job-starters are not diversified although they have the potential to do so. Households of this type could be found in all survey countries except Poland. This type is described by using the Bulgarian median household as an example.

The household operates a small farm (1.2 ha). Adult household members are on average comparatively young (43 years old) and highly educated (high school). The labour capacity is sufficient for non-farm income diversification (2 person equivalents) and the dependency ratio is low (0.67). The households are situated in more remote (45 km to the next large urban centre) and less developed regions (80% purchasing power). This may be the reasons why the households see, notwithstanding their good education, no particularly good or bad chances to find a job. Attitudes towards wage employment are very positive, but only indifferent towards self-employed activities (Table A 39).

The model concludes that the household faces a need for diversification. Internal conditions are favourable, and attitudes are positive. The model's outcome for the external conditions is ambiguous (Table A 40). Job-starters use their potential as farmers but pass up their chances for non-farm employment.

f) Pensioner households living under distress-push conditions (pensioners, N=128**)**

Pensioner households are not diversified and have no potential for non-farm income diversification. Within the SCARLED sample, pensioners were found in Bulgaria, Hungary, and Romania. Their situation is described on the basis of the median Romanian household.

The household has only a small farm (3.4 ha). The low labour capacity (0.5 person equivalents) corresponds with the high dependency ratio (3.0) and the high average age of adult household members (67 years old). The educational level is on a medium level (middle school). Due to their average high age, household members have no chances to find a job, although they are within commuting distance (19 km to the next large urban centre). The region is characterised as less developed (77.3% purchasing power). Attitudes towards wage and self-employment are very negative (Table A 35).

The model concludes that on the one hand the need for diversification is high. On the other hand, the internal conditions are adverse, and the external conditions are on a medium level. The attitudes towards diversification are generally negative (Table A 36).

5.5 Linear regression analysis

By linear regression analysis, it is tested whether the theory (Section 2.2) is implemented correctly into the knowledge base of the fuzzy logic model, i.e. a verification of the model is done. The testing is done by using the potential for non-farm income diversification as delivered from the model as dependent variable.[23] The independent variables are the ten model input variables. Table 16 shows the signs for the significant variables. Detailed results are in Table A 41 to Table A 45 in the Annex.

The coefficients of determination are sufficiently high and range from 0.50 for Slovenia to 0.75 for Romania. Not all variables are significant for all countries but every variable is significant for at least two countries. Therefore, it is concluded that all chosen variables contribute to assessing a household's potential for non-farm diversification and that there are no redundant variables in the model. With one exception, purchasing power in Hungary, all significant variables have the expected signs. Thus the theory from Section 2.2 was correctly implemented and the model shows the expected behaviour.

[23] The potential for non-farm income diversification is an index ranging from 0 to 1. Values near 0 show a low diversification potential while values near 1 indicate a high diversification potential for the household (Table 4).

Table 16: Signs of significant variables in linear regression analysis

Dependent variable	Simulated potential of non-farm income diversification				
	BG	**HU**	**PL**	**RO**	**SI**
Need for diversification					
Dependency ratio		+	+	+	+
Farm size	-	-	-		-
Internal conditions					
Age	-	-		-	
Education	+	+	+	+	+
Labour capacity		+			+
External conditions					
Remoteness	-		-		
Labour market	+		+		
Purchasing power		-	+	+	+
Attitudes towards employment alternatives					
Attitudes towards wage employment		+		+	+
Attitudes towards self-employment	+	+	+	+	+
R^2	0.56	0.58	0.65	0.75	0.50
N	223	218	199	224	213

Source: Own calculations with data from SCARLED survey.

In detail, education and attitudes towards wage employment are significant in all five countries. Their effect on household potential for non-farm diversification is positive. The dependency ratio, farm size, and purchasing power are significant in four countries. The effect of the dependency ratio is positive while the effect of farm size is negative. The effect of the regional purchasing power is positive in Poland, Romania, and Slovenia but negative in Hungary. The latter is not concordant with model's theoretical framework. Missing data for households in averagely and well developed regions[24] in Hungary may be an explanation for this behaviour. Age and attitudes towards self-employment are significant in three countries. The sign for age is negative and for attitudes towards self-employment positive. Household's labour capacity, remoteness, and the chances of finding a job on the labour market are significant in two countries. Household's labour capacity and the chances of finding a job on the labour market influence a household's potential for non-farm diversification positively while for households in more remote regions the potential decreases.

[24] The objective was to interview farm households in three regions, one well developed, one economically lagging behind, and one with an average development level. GDP per head was chosen as indicator for the state of development. In Hungary, the regional purchasing power per inhabitant was between 62.2% and 71.9% of national level in 2006 (Table A 5) thus the sample does not reflect the differences in economic development well.

5.6 Summary

The fuzzy logic model developed to assess the diversification potential of farm households behaves according to theory. For three quarters of the survey households from five NMS, the simulated potential for non-farm diversification is concordant with their actual behaviour. For another 8% of the households, the diverging behaviour can be explained by a fundamental difference of the household's diversification potential at an earlier point of time compared to the current situation, whereas the employment situation stayed the same. The remaining 17% of households are a conglomeration of households acting at the edge of diversification, are resistant to diversification pressure and opportunities due to more personal reasons, or are misclassified due to incorrect answers during the interviews or model errors. Nevertheless, the model can be used for simulating future developments in terms of changing diversification potential and for assessing the impact of policy measures.

Six types of households were identified according to their empirical characteristics: (a) households acting under a demand-pull environment (diversifiers by choice), (b) households that still enjoy the benefits of a past demand-pull environment (past diversifiers by choice), (c) non-diversified households with a strong focus on farming (farmers), (d) distress-push diversifier households (diversifiers through necessity), (e) possible job-starter households (job-starters), and (f) pensioner households living under distress-push conditions (pensioners). **Diversifiers by choice** are not under need for diversification but have positive attitudes towards non-farm diversification and make use of their good internal and external conditions. **Past diversifiers by choice** are comparable to the households acting under a demand-pull environment, but their external conditions have changed and are not favourable any more. **Farmers** operate farms that are large enough to sustain their families. Thus they are not in need for diversification. Regardless their internal and external conditions and attitudes towards employment alternatives, they decide against diversifiation. As the name implies, **diversifiers through necessity** are under pressure to diversify due to their small farms. Their attitudes towards employment alternatives are highly positive and their internal conditions are so good that they diversify even when external conditions are not explicitly favourable. **Job-starters** are under high pressure to diversify and show positive attitudes towards non-farm income activities. However, ambiguous internal or external conditions hamper diversification. **Pensioners** face a need for diversification but unfavourable internal and external conditions prevent income diversification. Furthermore, attitudes towards employment alternatives are seldom positive in this household type.

6 FUTURE DEVELOPMENTS

The six household types that were identified in Section 5.4 are considered archetypes for different stages of a farm household's life cycle. To show possible development paths in the cycle, a simple simulation is done: two of the ten input variables are manipulated to show the impact of time, i.e. (1) age is increased to 60 years and (2) chances of finding a job on the labour market are decreased to 'bad'. By this, the internal and external conditions of the household become worse and the simulation shows the most likely development path when the household continues as at present. The simulated median household for the six types is the same as it was described in Section 5.4. Detailed tables with simulation results are given in Table A 46 to Table A 51 in the Annex. The findings are summarised in Figure 8 that shows development paths of the household types.

Diversifiers by choice

The actually diversified Slovenian household with diversification potential is simulated. Households will lose their potential to diversify over the years and become households that still enjoy the benefits of a past demand-pull environment (Table A 46). But no matter whether they will lose their employment or getting retired, their farms can provide them with a decent income to cover their daily needs. In the last stage, they will be farmers[25], ideally with a pension from former waged employment. Thus, households of this type are not likely to get impoverished.

Past diversifiers by choice

The Bulgarian household is simulated. The household's potential to diversify will further deteriorate (Table A 47). Over the years, household members will either lose their employment or get retired. Finally, households in this category will switch to the farmer type of households. They will probably not face poverty because their farms are sufficiently large.[26] Additionally, they are likely to receive an income from the pension system.

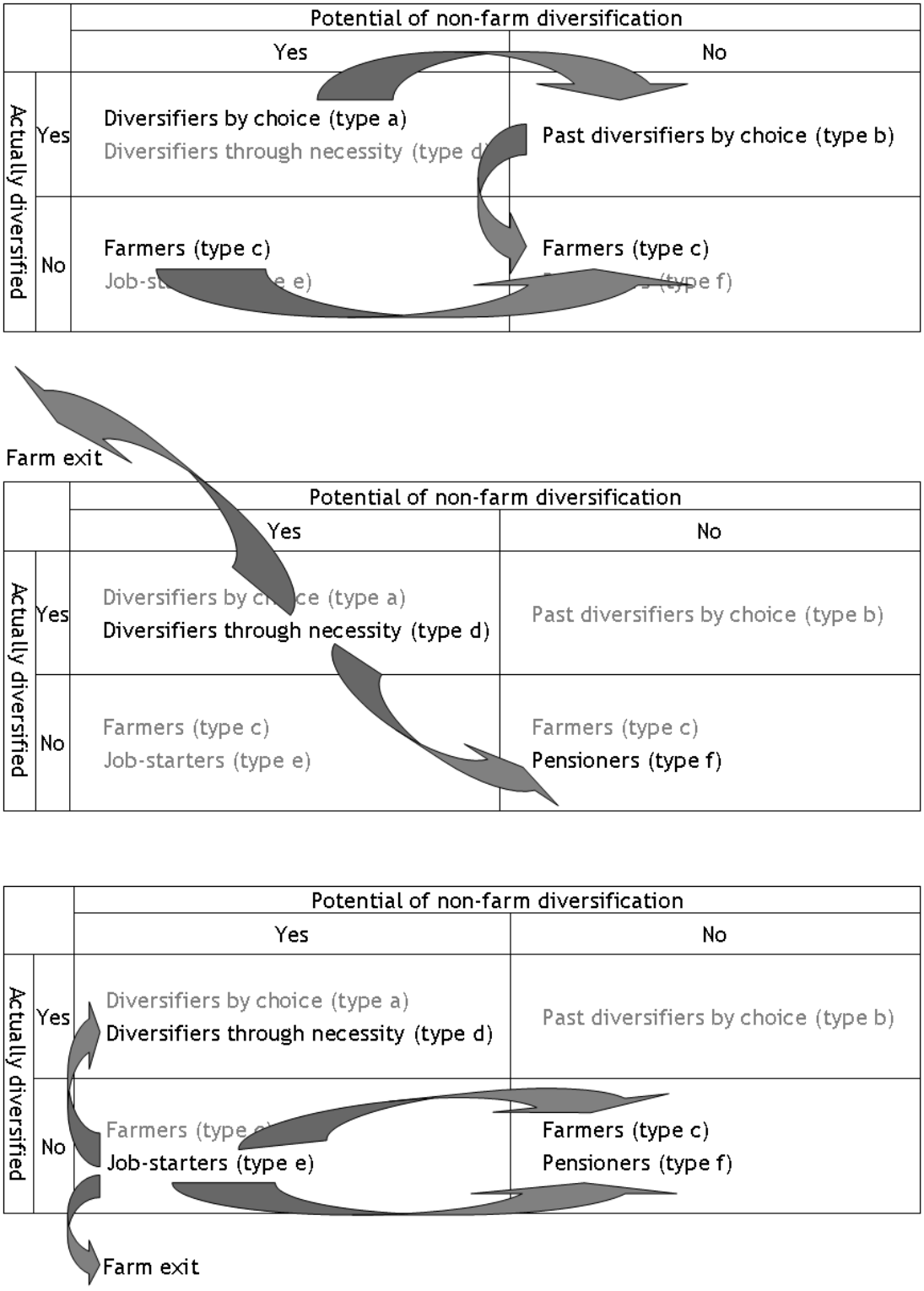
Farmers

Farmers can have a diversification potential or not. The Polish farm household is simulated for the case of an existing diversification potential. For the case of no existing diversification potential, the Slovenian household is simulated.

[25] The average farm size in Slovenia was 7.5 ha agricultural area in 2007; 81% of Slovenian farms are in size between 1 to 8 ESU and another 12% are between 8 to 16 ESU (Eurostat 2008a, analysis excludes farms smaller than 1 ESU). Thus, the simulated median Slovenian household fits well in the national farmers' category.

[26] The average farm size in Bulgaria was 24.3 ha in 2007 but with a strong dual farm structure; 90% of Bulgarian farms are in size between 1 and 8 ESU and another 4% are between 8 to 16 ESU (Eurostat 2010c, analysis excludes farms smaller than 1 ESU). Thus, the simulated median Bulgarian household fits well in the category of better off sole holders in Bulgaria.

Figure 8: Development paths of farm households



Source: Own figure.

The Polish farm households will lose their diversification potential and continue as farmers[27] (Table A 48). The Slovenian farmers are already 60 years old and have no diversification potential. They will only face worse external conditions (Table A 49) but do not change the household type. Focussing on agriculture seems straightforward for full-time farmers. They are experienced in this strategy and without external shocks they are likely to continue without facing poverty.

Diversifiers through necessity

The Polish household is used for simulation. Although households are fine in their current situation, they will face deteriorating internal and external conditions over the years to come (Table A 50). However, in their case, when getting unemployed or retired the farm will not be sufficiently large to provide for a carefree livelihood. Households will find themselves confronted with an even stronger distress-push environment than before. Otherwise, these households have still the chance to leave the agricultural sector and focus on non-farm employment. When they continue as at present, they are likely to end up in the pensioners' type. Thus, without functioning unemployment benefits and pension systems in place, households will probably face poverty.

Job-starters

This type is simulated on the basis of the Bulgarian household who has a diversification potential but is actually not diversified. Job-starters initially still have the opportunity to embark in farm development and to become full-time farmers, to diversify, or to leave the agricultural sector. Nevertheless, over the years, they will lose some of their potential for non-farm income diversification (Table A 51). Therefore it is of particular importance for these households to take appropriate action in time. If they do not develop their employment activities, either by developing the farming business or diversifying or exiting the agricultural sector, it is very likely that they will end up as pensioners facing a comparable distress-push environment.

Pensioners

The current situation of pensioner households is worse than the simulated one, i.e. their age is 60 years in Hungary, 62 years in Bulgaria, and 67 years in Romania and the chances on the labour market are rated in unison as very bad in all three countries (Table A 35). Thus, improvement of the situation is unlikely and further simulations are redundant. Of all household types, pensioners are expected to be most exposed to poverty. For these households, no rural development measures, but social security benefits and pension systems are urgently needed from a policy point of view.

The findings from Section 5.4 and the simulations of future developments are summarised in a model of farm households' development paths (Figure 8). When a farm household does

[27] The average farm size in Poland was 12.3 ha in 2007; 78% of Polish farms are in size between 1 and 8 ESU and another 13% are between 8 to 16 ESU (Eurostat 2008b, analysis excludes farms smaller than 1 ESU). Thus, the simulated median Polish household fits well in the category of farmers in Poland.

not exit the agricultural sector, it will end its development as a household of farmers' or pensioners' type. While farmers are expected to sustain their livelihoods with their farms, pensioners will most likely face poverty in a distress-push environment when they do not have a decent income from pension systems.

Various development strategies are possible for farm households, i.e. continuing as at present, farm development, non-farm income diversification, and stopping farming. Continuing as at present seems to be a feasible option for farmers and diversifiers by choice. Farm development is a likely option for farmers and job-starters while stopping farming seems feasible for diversifiers through necessity and job-starters. Non-farm income diversification is still possible for job-starters.

7 POLICY RECOMMENDATIONS

The livelihoods of many small farm households in the researched five NMS (Bulgaria, Hungary, Poland, Romania, and Slovenia) ask for taking policy action in terms of the households' future involvement in a lively rural non-farm sector. Policy measures should ideally not address a single aspect, e.g. education, but follow a holistic approach. It is suggested to include all key determinants that were identified in the fuzzy logic model to influence the farm household potential for non-farm diversification: the households' need for diversification, preferences for several income activities as well as the internal and external conditions.

By this, the interplay of the key determinants is taken into account. Households without a need for diversification will only embark on non-farm employment when all other key determinants are favourable. Households facing a need for diversification can only diversify when the educational level of household members and the labour market conditions allow for non-farm employment. Preferences for specific income activities determine whether a household will engage in a particular non-farm income activity or not. While positive preferences may cause that people get engaged in non-farm employment although internal or external conditions are less favourable, negative preferences will prevent non-farm employment.

Whereas preferences are difficult to change, need for diversification, and especially internal and external conditions could be addressed by politicians. For instance, farm development measures decrease the need for diversification by increasing farm income, education and training measures improve the internal household conditions for diversification while labour market measures influence the external conditions positively.

Farm households are not a homogenous group. While some of them operate larger farms or earn a sizeable non-farm income, others have only small land plots at their disposal and are too old or insufficiently educated for the labour market. Thus fine-tuning and targeting of policies is needed for efficient support. From the analysis the following conclusions are drawn:

- For a remarkable share of households, i.e. households that operate only small farms and have no potential to diversify their income sources due to their high age, general social policies are recommended instead of rural development policies.
- Measures that support farm exit of households which operate only small farms but earn a sizeable non-farm income could promote structural change without causing social hardships. For these households, training and labour market measures could be an ideal complement to a farm exit measure.
- Special attention deserves households which operate only small farms and are not engaged in non-farm employment although their age and education would allow for it. Theoretically, those households could embark on non-farm employment or develop their farms. However, considering the poor asset situation, i.e. land and financial capital, of the households, it seems questionable whether farm development is a feasible option for them. Alternatively, training and labour market measures could provide the initial spark to start non-farm wage employment.
- Farm investments should be offered to all households which show the will, expertise and potential to develop their farms in a viable way. Complementing the

farm investment support by professional training and advice by extension experts in terms of how to access modern agri-food chains is recommended.

Of special interest is rural non-farm self-employment. Although the promotion of small businesses may look promising, it always needs seed money, business ideas, and well-funded consumers. Seed money, usually equity capital, is a rare resource in the NMS and consumers are more likely found near prospering urban centres or in regions having high value for tourists. Thus, the potential for rural non-farm self-employment is often limited and it depends on the economic environment but also the mentality of the rural population. Thus, fostering the development by subsidised seed money or investments could be a hazardous and expensive attempt.

In the end, socio-psychological factors like preferences and attitudes are important determinants of what a household decides in terms of its employment strategies. Although they are hard to change and thus difficult to address by policies, it is important to take these factors into account when deciding about certain target groups and the assessment which types of farm households are likely to respond to certain policy measures and which are not.

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ANNEX

Table A 1: Bulgaria: descriptive statistics of metric variables

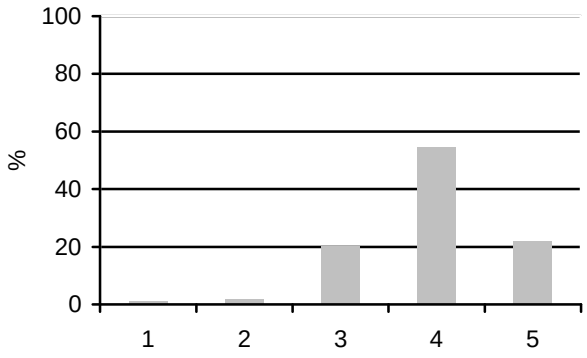
	Min	P_5 [1)]	Median	P_{95} [2)]	Max	Mean [3)]	Std. dev. [4)]
Dependency ratio	0.00	0.00	0.50	3.00	3.00	0.83	0.96
Farm size	0.00	0.10	2.61	64.90	3800.00	38.25	288.40
Age	22.00	31.55	43.50	69.90	78.00	47.04	12.19
Labour capacity	0.00	0.50	2.00	4.95	7.00	2.51	1.28
Remoteness	10.00	10.00	53.00	78.00	78.00	48.17	18.02

Source: Own calculations with data from SCARLED survey.

Note: N=223, [1)] 5th percentile, [2)] 95th percentile, [3)] arithmetic mean, [4)] standard deviation.

Table A 2: Bulgaria: descriptive statistics for education

	Frequency	
	Number	%
No schooling (1)	3	1.3
Primary school (2)	4	1.8
Middle school (3)	45	20.2
High school (4)	122	54.7
University (5)	49	22.0

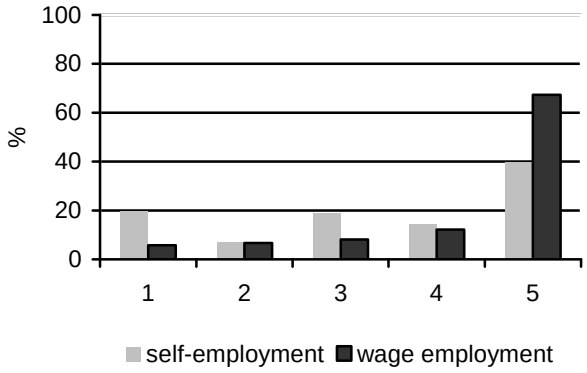


Source: Own calculations with data from SCARLED survey.

Note: N=223.

Table A 3: Bulgaria: descriptive statistics for attitudes

	Frequency	
	Number	%
Towards self-employment		
Very negative (1)	44	19.7
Somewhat negative (2)	16	7.2
Indifferent (3)	42	18.8
Somewhat positive (4)	32	14.3
Very positive (5)	89	39.9
Towards wage employment		
Very negative (1)	13	5.8
Somewhat negative (2))	15	6.7
Indifferent (3)	18	8.1
Somewhat positive (4)	27	12.1
Very positive (5)	150	67.3

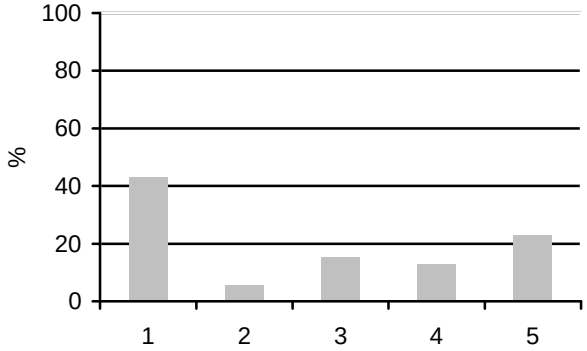


Source: Own calculations with data from SCARLED survey.

Note: N=223.

Table A 4: Bulgaria: descriptive statistics for labour market

	Frequency	
	Number	%
Very bad (1)	96	43.0
Bad (2)	13	5.8
Neither bad nor good (3)	34	15.2
Good (4)	29	13.0
Very good (5)	51	22.9



Source: Own calculations with data from SCARLED survey.

Note: N=223.

Table A 5: Regional purchasing power[1)] (% of country's average purchasing power), 2006

Region	%
Bulgaria	100.0
Burgas	98.6
Pazardzhik	80.0
Veliko Tarnovo	71.3
Hungary	100.0
Bács-Kiskun	66.3
Haidú-Bihar	71.9
Somogy	62.2
Poland	100.0
Dolnoslaskie	107.0
Kujawsko-Pomorskie	87.4
Mazowieckie	159.7
Podkarpackie	68.4
Podlaskie	73.4
Romania	100.0
Bihor	99.6
Dolj	77.3
Timis	151.6
Slovenia	100.0
Notranjsko-Kraska	74.6
Osrednjeslovenska	144.2
Podravska	84.4

Source: Own calculation with data from Eurostat (2009).

Note: [1)] Purchasing power parities per inhabitant at NUTS level 3.

Table A 6: Bulgaria: remoteness[1)]

Region/Village	km
Burgas	
Ekzarh Antimovo	55.0
Krumovo Gradishte	53.0
Nevestino	58.0
Pazardzhik	
Dorkovo	42.0
Gelemenovo	10.0
Kostandovo	38.0
Veliko Tarnovo	
Karaisen	60.0
Morava	78.0
Nedan	45.0

Source: Data from SCARLED survey.

Note: [1)] Distance to the next large urban centre (km).

Table A 7: Descriptive statistics for diversified households[1)]

	Diversified households	
	Number	%
Bulgaria (N=223)	140	62.8
Hungary (N=218)	144	66.1
Poland (N=199)	125	62.8
Romania (N=224)	149	66.5
Slovenia (N=213)	165	77.5
Total (N=1077)	723	67.1

Source: Own calculation with data from SCARLED survey.

Note: [1)] self-employment and wage employment.

Table A 8: Hungary: descriptive statistics of metric variables

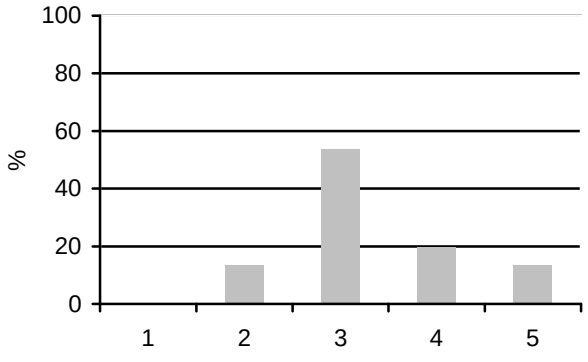
	Min	P_5[1)]	Median	P_{95}[2)]	Max	Mean[3)]	Std. dev.[4)]
Dependency ratio	0.00	0.00	0.25	3.00	3.00	0.58	0.85
Farm size	0.04	0.20	4.75	96.00	335.00	18.40	41.24
Age	25.00	32.93	43.83	69.20	91.00	46.69	11.71
Labour capacity	0.00	0.50	2.00	4.00	6.00	2.38	1.05
Remoteness	8.00	8.00	13.00	33.00	33.00	16.33	7.80

Source: Own calculations with data from SCARLED survey.

Note: N=218, [1)] 5th percentile, [2)] 95th percentile, [3)] arithmetic mean, [4)] standard deviation.

Table A 9: Hungary: descriptive statistics for education

	Frequency	
	Number	%
No schooling (1)	0	0.0
Primary school (2)	29	13.3
Middle school (3)	117	53.7
High school (4)	43	19.7
University (5)	29	13.3

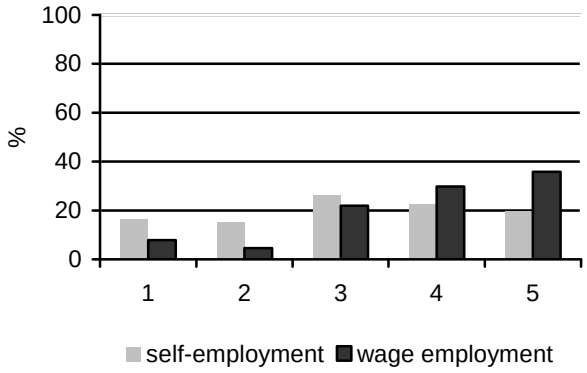


Source: Own calculations with data from SCARLED survey.

Note: N=218.

Table A 10: Hungary: descriptive statistics for attitudes

	Frequency	
	Number	%
Towards self-employment		
Very negative (1)	36	16.5
Somewhat negative (2)	33	15.1
Indifferent (3)	57	26.1
Somewhat positive (4)	49	22.5
Very positive (5)	43	19.7
Towards wage employment		
Very negative (1)	17	7.8
Somewhat negative (2)	10	4.6
Indifferent (3)	48	22.0
Somewhat positive (4)	65	29.8
Very positive (5)	78	35.8

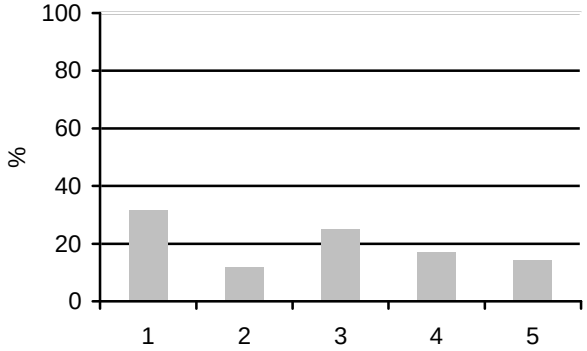


Source: Own calculations with data from SCARLED survey.

Note: N=218.

Table A 11: Hungary: descriptive statistics for labour market

	Frequency	
	Number	%
Very bad (1)	69	31.7
Bad (2)	26	11.9
Neither bad nor good (3)	55	25.2
Good (4)	37	17.0
Very good (5)	31	14.2



Source: Own calculations with data from SCARLED survey.

Note: N=218.

Table A 12: Hungary: remoteness[1)]

Region/Village	km
Bács-Kiskun	
Érsekcsanád	10.0
Fülöpháza	21.0
Kaskantyú	11.0
Haidú-Bihar	
Bagamér	33.0
Hortobágy	24.0
Nagyhegyes	9.0
Somogy	
Bõszénfa	18.0
Kaposfõ	13.0
Szenna	8.0

Source: Data from SCARLED survey.

Note: [1)] Distance to the next large urban centre (km).

Table A 13: Poland: descriptive statistics of metric variables

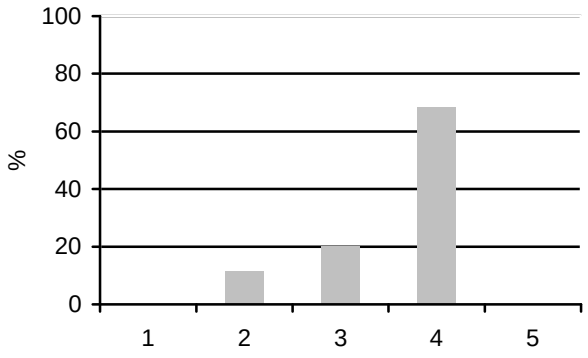
	Min	P_5[1)]	Median	P_{95}[2)]	Max	Mean[3)]	Std. dev.[4)]
Dependency ratio	0.00	0.00	0.50	2.00	3.00	0.69	0.78
Farm size	0.18	1.10	4.26	27.30	43.00	7.93	8.23
Age	26.00	30.50	41.00	60.50	87.00	42.82	9.87
Labour capacity	0.00	1.00	2.50	4.00	8.00	2.59	1.17
Remoteness	8.00	8.00	8.00	75.00	75.00	15.40	18.43

Source: Own calculations with data from SCARLED survey.

Note: N=199, [1)] 5th percentile, [2)] 95th percentile, [3)] arithmetic mean, [4)] standard deviation.

Table A 14: Poland: descriptive statistics for education

	Frequency	
	Number	%
No schooling (1)	0	0.0
Primary school (2)	23	11.6
Middle school (3)	40	20.1
High school (4)	136	68.3
University (5)	0	0.0

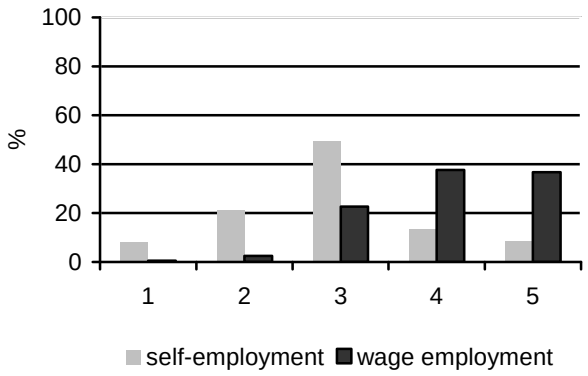


Source: Own calculations with data from SCARLED survey.

Note: N=199.

Table A 15: Poland: descriptive statistics for attitudes

	Frequency	
	Number	%
Towards self-employment		
Very negative (1)	16	8.0
Somewhat negative (2)	42	21.1
Indifferent (3)	98	49.2
Somewhat positive (4)	26	13.1
Very positive (5)	17	8.5
Towards wage employment		
Very negative (1)	1	0.5
Somewhat negative (2)	5	2.5
Indifferent (3)	45	22.6
Somewhat positive (4)	75	37.7
Very positive (5)	73	36.7

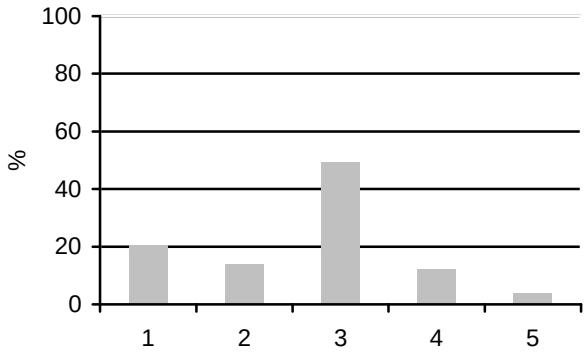


Source: Own calculations with data from SCARLED survey.

Note: N=199.

Table A 16: Poland: descriptive statistics for labour market

	Frequency	
	Number	%
Very bad (1)	41	20.6
Bad (2)	28	14.1
Neither bad nor good (3)	98	49.2
Good (4)	24	12.1
Very good (5)	8	4.0



Source: Own calculations with data from SCARLED survey.

Note: N=199.

Table A 17: Poland: remoteness[1)]

Region/Village	km
Dolnoslaskie	
Witoszów Dolny	8.0
Kujawsko-Pomorskie	
Slawsk Wielki	15.0
Mazowieckie	
Bialyszewo	10.0
Chrzczany	8.0
Ulasek	15.0
Podkarpackie	
Bzianka	8.0
Wróblowa	11.0
Podlaskie	
Andryjanki	75.0
Swieck Wielki	8.0

Source: Data from SCARLED survey.

Note: [1)] Distance to the next large urban centre (km).

Table A 18: Romania: descriptive statistics of metric variables

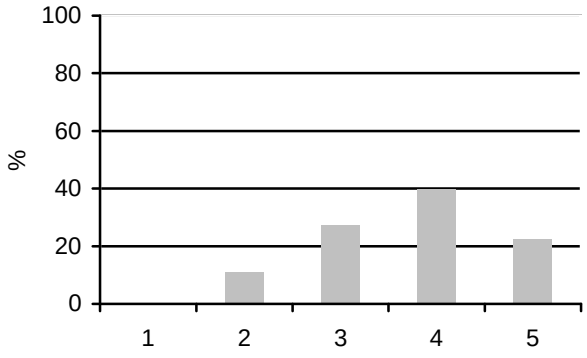
	Min	P_5 [1)]	Median	P_{95} [2)]	Max	Mean [3)]	Std. dev. [4)]
Dependency ratio	0.00	0.00	0.33	3.00	3.00	0.77	1.02
Farm size	0.08	1.08	3.10	20.33	350.00	7.67	26.61
Age	23.00	30.00	46.50	73.00	87.00	48.45	12.65
Labour capacity	0.00	0.31	2.00	4.00	6.00	2.15	1.13
Remoteness	10.00	10.00	18.00	30.00	30.00	19.12	8.21

Source: Own calculations with data from SCARLED survey.

Note: N=224, [1)] 5th percentile, [2)] 95th percentile, [3)] arithmetic mean, [4)] standard deviation.

Table A 19: Romania: descriptive statistics for education

	Frequency	
	Number	%
No schooling (1)	0	0.0
Primary school (2)	24	10.7
Middle school (3)	61	27.2
High school (4)	89	39.7
University (5)	50	22.3

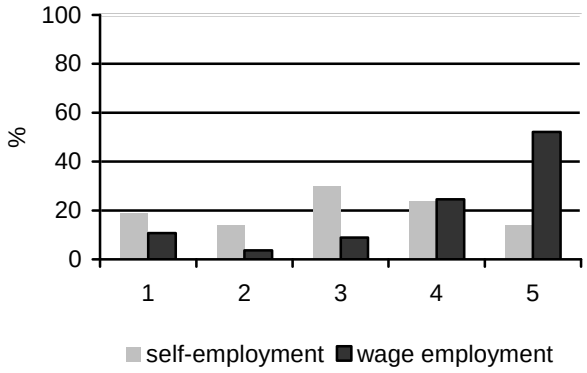


Source: Own calculations with data from SCARLED survey.

Note: N=224.

Table A 20: Romania: descriptive statistics for attitudes

	Frequency	
	Number	%
Towards self-employment		
Very negative (1)	42	18.8
Somewhat negative (2)	31	13.8
Indifferent (3)	67	29.9
Somewhat positive (4)	53	23.7
Very positive (5)	31	13.8
Towards wage employment		
Very negative (1)	24	10.7
Somewhat negative (2)	8	3.6
Indifferent (3)	20	8.9
Somewhat positive (4)	55	24.6
Very positive (5)	117	52.2

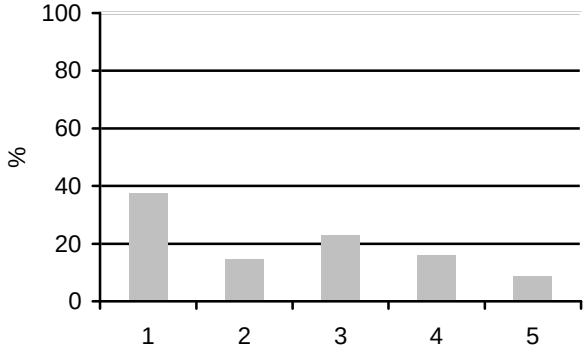


Source: Own calculations with data from SCARLED survey.

Note: N=224.

Table A 21: Romania: descriptive statistics for labour market

	Frequency	
	Number	%
Very bad (1)	84	37.5
Bad (2)	33	14.7
Neither bad nor good (3)	51	22.8
Good (4)	36	16.1
Very good (5)	20	8.9



Source: Own calculations with data from SCARLED survey.

Note: N=224.

Table A 22: Romania: remoteness[1)]

Region/Village	km
Bihor	
Ciumeghiu	10.0
Sacadat	18.0
Suncuius	28.0
Dolj	
Breasta	10.0
Celaru	19.0
Sopot	30.0
Timis	
Dudestii Noi	12.0
Giarmata	12.0
Sat Chinez	30.0

Source: Data from SCARLED survey.

Note: [1)] Distance to the next large urban centre (km).

Table A 23: Slovenia: descriptive statistics of metric variables

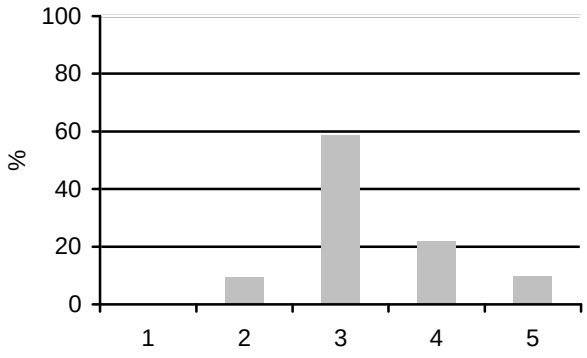
	Min	P_5[1)]	Median	P_{95}[2)]	Max	Mean[3)]	Std. dev.[4)]
Dependency ratio	0.00	0.00	0.67	3.00	3.00	0.91	0.92
Farm size	0.03	0.21	8.00	32.00	68.60	11.11	11.12
Age	26.00	32.50	41.00	69.15	80.00	43.46	10.62
Labour capacity	0.00	0.75	3.00	5.00	7.50	2.80	1.22
Remoteness	4.00	4.00	15.00	22.00	22.00	14.23	5.13

Source: Own calculations with data from SCARLED survey.

Note: N=213, [1)] 5th percentile, [2)] 95th percentile, [3)] arithmetic mean, [4)] standard deviation.

Table A 24: Slovenia: descriptive statistics for education

	Frequency	
	Number	%
No schooling (1)	0	0.0
Primary school (2)	20	9.4
Middle school (3)	125	58.7
High school (4)	47	22.1
University (5)	21	9.9

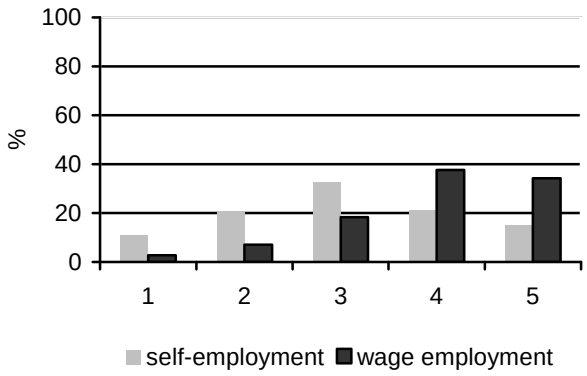


Source: Own calculations with data from SCARLED survey.

Note: N=213.

Table A 25: Slovenia: descriptive statistics for attitudes

	Frequency	
	Number	%
Towards self-employment		
Very negative (1)	23	10.8
Somewhat negative (2)	44	20.7
Indifferent (3)	69	32.4
Somewhat positive (4)	45	21.1
Very positive (5)	32	15.0
Towards wage employment		
Very negative (1)	6	2.8
Somewhat negative (2)	15	7.0
Indifferent (3)	39	18.3
Somewhat positive (4)	80	37.6
Very positive (5)	73	34.3

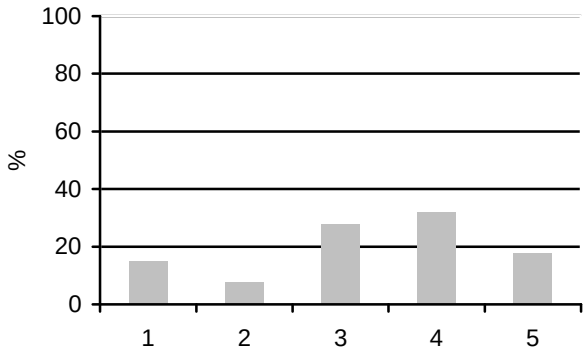


Source: Own calculations with data from SCARLED survey.

Note: N=213.

Table A 26: Slovenia: descriptive statistics for labour market

	Frequency	
	Number	%
Very bad (1)	32	15.0
Bad (2)	16	7.5
Neither bad nor good (3)	59	27.7
Good (4)	68	31.9
Very good (5)	38	17.8



Source: Own calculations with data from SCARLED survey.

Note: N=213.

Table A 27: Slovenia: remoteness[1)]

Region/Village	km
Notranjsko-kraska	
Cerknica	15.0
Ilirska Bistrica	22.0
Loski Dolina	16.0
Osrednjeslovenska	
Dobrova- Polhov Gradec	20.0
Medvode	12.0
Smartno/Litiji	4.0
Podravska	
Cerkvenjak	10.0
Markovci	11.0
Ruse	15.0

Source: Data from SCARLED survey.

Note: [1)] Distance to the next large urban centre (km).

Table A 28: Bulgaria: significant differences between households with (N=146) and without non-farm potential (N=77)

Variable	Median	Mean rank	Significance level
Dependency ratio			**
without non-farm potential	0.67	124.12	
with non-farm potential	0.50	105.61	
Farm size			***
without non-farm potential	7.05	143.14	
with non-farm potential	1.75	95.58	
Age			***
without non-farm potential	57.50	149.76	
with non-farm potential	42.00	92.09	
Education			
without non-farm potential	4.00	113.32	
with non-farm potential	4.00	111.30	
Labour capacity			***
without non-farm potential	2.00	79.38	
with non-farm potential	2.63	129.20	
Remoteness			***
without non-farm potential	58.00	158.56	
with non-farm potential	42.00	87.45	
Labour market			***
without non-farm potential	1.00	83.92	
with non-farm potential	3.00	126.81	
Purchasing power			
without non-farm potential	71.25	103.62	
with non-farm potential	80.04	116.42	
Attitudes towards wage employment			***
without non-farm potential	5.00	92.34	
with non-farm potential	5.00	122.37	
Attitudes towards self-employment			***
without non-farm potential	3.00	96.38	
with non-farm potential	4.00	120.24	

Source: Own calculations with data from SCARLED survey.

Notes: Significance levels of Mann-Whitney test: * 10%, ** 5%, and *** 1%.

Table A 29: Hungary: significant differences between households with (N=135) and without non-farm potential (N=83)

Variable	Median	Mean rank	Significance level
Dependency ratio			*
without non-farm potential	0.33	118.52	
with non-farm potential	0.17	103.96	
Farm size			**
without non-farm potential	9.00	122.39	
with non-farm potential	3.80	101.57	
Age			***
without non-farm potential	57.00	150.92	
with non-farm potential	40.00	84.03	
Education			***
without non-farm potential	3.00	82.99	
with non-farm potential	3.00	125.80	
Labour capacity			***
without non-farm potential	2.00	72.30	
with non-farm potential	3.00	132.37	
Remoteness			
without non-farm potential	18.00	114.02	
with non-farm potential	13.00	106.72	
Labour market			***
without non-farm potential	1.00	56.92	
with non-farm potential	3.00	141.83	
Purchasing power			
without non-farm potential	66.34	114.69	
with non-farm potential	66.34	106.31	
Attitudes towards wage employment			***
without non-farm potential	3.00	86.85	
with non-farm potential	4.00	123.43	
Attitudes towards self-employment			**
without non-farm potential	3.00	98.25	
with non-farm potential	3.00	116.41	

Source: Own calculations with data from SCARLED survey.

Notes: Significance levels of Mann-Whitney test: * 10%, ** 5%, and *** 1%.

Table A 30: Poland: significant differences between households with (N=163) and without non-farm potential (N=36)

Variable	Median	Mean rank	Significance level
Dependency ratio			
without non-farm potential	0.33	90.21	
with non-farm potential	0.50	102.16	
Farm size			***
without non-farm potential	10.47	136.90	
with non-farm potential	3.48	91.85	
Age			***
without non-farm potential	49.00	143.15	
with non-farm potential	40.00	90.47	
Education			***
without non-farm potential	3.00	51.50	
with non-farm potential	4.00	110.71	
Labour capacity			***
without non-farm potential	2.00	74.19	
with non-farm potential	3.00	105.70	
Remoteness			***
without non-farm potential	13.00	129.43	
with non-farm potential	8.00	93.50	
Labour market			***
without non-farm potential	2.00	82.03	
with non-farm potential	3.00	103.97	
Purchasing power			**
without non-farm potential	73.37	78.76	
with non-farm potential	106.97	104.69	
Attitudes towards wage employment			***
without non-farm potential	3.00	43.47	
with non-farm potential	4.00	112.48	
Attitudes towards self-employment			**
without non-farm potential	3.00	83.63	
with non-farm potential	3.00	103.62	

Source: Own calculations with data from SCARLED survey.

Notes: Significance levels of Mann-Whitney test: * 10%, ** 5%, and *** 1%.

Table A 31: Romania: significant differences between households with (N=190) and without non-farm potential (N=34)

Variable	Median	Mean rank	Significance level
Dependency ratio			***
without non-farm potential	3.00	153.53	
with non-farm potential	0.33	105.16	
Farm size			*
without non-farm potential	3.86	129.35	
with non-farm potential	3.03	109.48	
Age			***
without non-farm potential	66.00	186.16	
with non-farm potential	43.88	99.32	
Education			***
without non-farm potential	3.00	58.15	
with non-farm potential	4.00	122.23	
Labour capacity			***
without non-farm potential	0.75	38.19	
with non-farm potential	2.00	125.80	
Remoteness			
without non-farm potential	19.00	126.44	
with non-farm potential	18.00	110.01	
Labour market			***
without non-farm potential	1.00	54.06	
with non-farm potential	3.00	122.96	
Purchasing power			***
without non-farm potential	77.31	52.10	
with non-farm potential	99.61	123.31	
Attitudes towards wage employment			***
without non-farm potential	1.00	25.16	
with non-farm potential	5.00	128.13	
Attitudes towards self-employment			***
without non-farm potential	1.00	33.66	
with non-farm potential	3.00	126.61	

Source: Own calculations with data from SCARLED survey.

Notes: Significance levels of Mann-Whitney test: * 10%, ** 5%, and *** 1%.

Table A 32: Slovenia: significant differences between households with (N=187) and without non-farm potential (N=26)

Variable	Median	Mean rank	Significance level
Dependency ratio			
without non-farm potential	1.00	121.50	
with non-farm potential	0.67	104.98	
Farm size			***
without non-farm potential	12.50	141.52	
with non-farm potential	7.13	102.20	
Age			**
without non-farm potential	44.67	130.56	
with non-farm potential	40.67	103.72	
Education			***
without non-farm potential	2.50	56.67	
with non-farm potential	3.00	114.00	
Labour capacity			**
without non-farm potential	2.00	80.40	
with non-farm potential	3.00	110.70	
Remoteness			
without non-farm potential	15.00	109.17	
with non-farm potential	15.00	106.70	
Labour market			***
without non-farm potential	2.00	72.90	
with non-farm potential	4.00	111.74	
Purchasing power			
without non-farm potential	84.44	109.60	
with non-farm potential	84.44	106.64	
Attitudes towards wage employment			***
without non-farm potential	3.00	63.71	
with non-farm potential	4.00	113.02	
Attitudes towards self-employment			***
without non-farm potential	2.00	68.81	
with non-farm potential	3.00	112.31	

Source: Own calculations with data from SCARLED survey.

Notes: Significance levels of Mann-Whitney test: * 10%, ** 5%, and *** 1%.

Table A 33: Actually diversified households with a diversification potential: median of model variables by country

	BG (N=109)	HU (N=112)	PL (N=115)	RO (N=146)	Sl (N=151)
Need for diversification					
Dependency ratio	0.50	0.29	0.33	0.25	0.50
Farm size	1.80	4.00	2.80	3.00	7.13
Internal conditions					
Age	41.50	39.88	39.00	42.00	39.00
Education	4.00	3.00	4.00	4.00	3.00
Labour capacity	3.00	3.00	3.00	2.25	3.00
External conditions					
Remoteness	42.00	13.00	8.00	18.00	15.00
Labour market	3.00	3.50	3.00	3.00	4.00
Purchasing power	80.04	66.34	87.40	99.61	84.44
Attitudes					
Attitudes towards wage employment	5.00	4.00	5.00	5.00	4.00
Attitudes towards self-employment	4.00	3.00	3.00	4.00	3.00

Source: Own calculations with data from SCARLED survey.

Table A 34: Actually diversified households with a diversification potential: model results for fuzzy subsets of intermediate variables and output variable for a median household[1)]

	BG (N=109)	HU (N=112)	PL (N=115)	RO (N=146)	Sl (N=151)
Need for diversification					
unnecessary	0.00	0.40	0.16	0.20	0.98
necessary	1.00	0.60	0.84	0.80	0.00
Internal conditions					
low	0.00	0.50	0.00	0.00	0.50
medium	0.00	0.00	0.00	0.00	0.00
high	0.85	0.50	0.90	0.80	0.50
External conditions					
low	0.40	0.25	0.25	0.01	0.00
medium	0.50	0.67	0.50	0.50	0.31
high	0.50	0.33	0.50	0.50	0.69
Attitudes					
negative	0.00	0.00	0.00	0.00	0.00
positive	1.00	0.50	0.50	1.00	0.50
Potential of non-farm diversification	0.85	0.54	0.68	0.84	0.50
low	0.00	0.40	0.16	0.01	0.50
high	0.50	0.50	0.50	0.50	0.50

Source: Own calculations with data from SCARLED survey.

Notes: [1)] The median of all input variables for the respective group of households was used to simulate a median household.

Table A 35: Not diversified households with no diversification potential: median of model variables by country

	BG (N=46)	HU (N=51)	PL (N=26)	RO (N=31)	Sl (N=12)
Need for diversification					
Dependency ratio	1.75	1.00	0.50	3.00	1.00
Farm size	4.64	8.00	9.31	3.37	12.50
Internal conditions					
Age	62.00	60.00	49.00	67.00	60.00
Education	4.00	3.00	2.00	3.00	2.50
Labour capacity	1.00	1.50	2.00	0.50	1.75
External conditions					
Remoteness	58.00	18.00	9.50	19.00	16.00
Labour market	1.00	1.00	1.50	1.00	2.50
Purchasing power	75.65	66.34	73.37	77.31	84.44
Attitudes					
Attitudes towards wage employment	4.00	3.00	3.00	1.00	2.50
Attitudes towards self-employment	3.00	3.00	3.00	1.00	2.00

Source: Own calculations with data from SCARLED survey.

Table A 36: Not diversified households with no diversification potential: model results for fuzzy subsets of intermediate variables and output variable for a median household[1)]

	BG (N=46)	HU (N=51)	PL (N=26)	RO (N=31)	Sl (N=12)
Need for diversification					
unnecessary	0.00	0.33	0.55	0.00	0.67
necessary	0.52	0.67	0.00	0.73	0.00
Internal conditions					
low	1.00	0.50	0.90	0.50	0.75
medium	0.00	0.00	0.00	0.00	0.00
high	0.00	0.00	0.00	0.00	0.00
External conditions					
low	0.51	0.67	0.53	0.45	0.31
medium	0.00	0.33	0.47	0.55	0.69
high	0.00	0.00	0.00	0.00	0.25
Attitudes					
negative	0.00	0.50	0.50	1.00	0.75
positive	0.50	0.50	0.50	0.00	0.25
Potential of non-farm diversification	0.15	0.43	0.15	0.15	0.15
low	0.50	0.50	0.50	0.50	0.67
high	0.00	0.33	0.00	0.00	0.00

Source: Own calculations with data from SCARLED survey.

Notes: [1)] The median of all input variables for the respective group of households was used to simulate a median household.

Table A 37: Actually diversified households with no diversification potential: median of model variables by country

	BG (N=31)	HU (N=32)	PL (N=10)	RO (N=3)	Sl (N=14)
Need for diversification					
Dependency ratio	0.50	0.00	0.00	0.00	1.00
Farm size	15.00	10.50	10.97	5.10	12.55
Internal conditions					
Age	46.33	51.25	47.59	57.00	42.25
Education	4.00	3.00	4.00	4.00	2.50
Labour capacity	2.00	2.00	2.25	2.00	2.63
External conditions					
Remoteness	60.00	11.00	75.00	19.00	11.50
Labour market	2.00	1.00	3.00	2.00	2.00
Purchasing power	71.25	66.34	73.37	99.61	84.44
Attitudes					
Attitudes towards wage employment	5.00	4.00	4.00	4.00	3.00
Attitudes towards self-employment	3.00	3.00	3.00	3.00	2.00

Source: Own calculations with data from SCARLED survey.

Table A 38: Actually diversified households with no diversification potential: model results for fuzzy subsets of intermediate variables and output variable for a median household[1)]

	BG (N=31)	HU (N=32)	PL (N=10)	RO (N=3)	Sl (N=14)
Need for diversification					
unnecessary	1.00	0.70	0.79	0.62	0.67
necessary	0.00	0.00	0.00	0.38	0.00
Internal conditions					
low	0.00	0.50	0.00	0.70	0.75
medium	0.00	0.00	0.00	0.00	0.00
high	0.63	0.50	0.76	0.30	0.25
External conditions					
low	0.57	0.67	0.50	0.01	0.31
medium	0.00	0.33	0.47	0.99	0.69
high	0.00	0.00	0.00	0.00	0.00
Attitudes					
negative	0.00	0.00	0.00	0.00	0.50
positive	0.50	0.50	0.50	0.50	0.50
Potential of non-farm diversification	0.15	0.43	0.49	0.45	0.38
low	0.50	0.50	0.50	0.50	0.50
high	0.00	0.33	0.47	0.38	0.25

Source: Own calculations with data from SCARLED survey.

Notes: [1)] The median of all input variables for the respective group of households was used to simulate a median household.

Table A 39: Not diversified households with a diversification potential: median of model variables by country

	BG (N=37)	HU (N=23)	PL (N=48)	RO (N=44)	Sl (N=36)
Need for diversification					
Dependency ratio	0.67	0.00	1.00	0.50	2.00
Farm size	1.20	3.00	9.81	4.04	7.25
Internal conditions					
Age	43.00	41.00	43.00	54.67	49.50
Education	4.00	3.00	4.00	3.00	3.00
Labour capacity	2.00	2.00	2.00	1.50	1.38
External conditions					
Remoteness	45.00	18.00	8.00	12.00	15.00
Labour market	3.00	3.00	2.00	1.00	3.00
Purchasing power	80.04	66.34	106.97	99.61	144.19
Attitudes					
Attitudes towards wage employment	5.00	4.00	4.00	4.00	4.00
Attitudes towards self-employment	3.00	4.00	3.00	3.00	3.00

Source: Own calculations with data from SCARLED survey.

Table A 40: Not diversified households with a diversification potential: model results for fuzzy subsets of intermediate variables and output variable for a median household[1)]

	BG (N=37)	HU (N=23)	PL (N=48)	RO (N=44)	Sl (N=36)
Need for diversification					
unnecessary	0.00	0.20	0.56	0.40	0.00
necessary	0.77	0.80	0.44	0.60	0.95
Internal conditions					
low	0.00	0.50	0.00	0.50	0.50
medium	0.00	0.00	0.00	0.50	0.50
high	0.70	0.50	0.70	0.50	0.38
External conditions					
low	0.50	0.50	0.00	0.01	0.00
medium	0.50	0.50	1.00	0.99	0.50
high	0.50	0.33	0.00	0.00	0.50
Attitudes					
negative	0.00	0.00	0.00	0.00	0.00
positive	0.50	1.00	0.50	0.50	0.50
Potential of non-farm diversification	0.85	0.50	0.85	0.54	0.85
low	0.00	0.50	0.00	0.40	0.00
high	0.50	0.50	0.50	0.50	0.50

Source: Own calculations with data from SCARLED survey.

Notes: [1)] The median of all input variables for the respective group of households was used to simulate a median household.

Table A 41: Bulgaria: results for linear regression analysis

	Simulated potential of non-farm diversification			
	Full model[1)]		Reduced model[2)]	
	Standardised coefficient	Significance level[3)]	Standardised coefficient	Significance level[3)]
Need for diversification				
Dependency ratio	0.03			
Farm size	-0.10	**	-0.10	**
Internal conditions				
Age	-0.30	***	-0.30	***
Education	0.10	*	0.12	**
Labour capacity	0.02			
External conditions				
Remoteness	-0.30	***	-0.30	***
Labour market	0.33	***	0.33	***
Purchasing power	-0.04			
Attitudes				
Attitudes towards wage employment	0.25	***	0.25	***
Attitudes towards self-employment	0.02			
R^2	0.55		0.56	
N	223		223	

Source: Own calculations with data from SCARLED survey.

Notes: [1)] Model containing all ten input variables. [2)] Model containing only significant variables. [3)] Significance levels of t-Test: * 10%, ** 5%, and *** 1%.

Table A 42: Hungary: results for linear regression analysis

	Simulated potential of non-farm diversification			
	Full model[1)]		Reduced model[2)]	
	Standardised coefficient	Significance level[3)]	Standardised coefficient	Significance level[3)]
Need for diversification				
Dependency ratio	0.15	***	0.12	**
Farm size	-0.12	**	-0.12	***
Internal conditions				
Age	-0.13	**	-0.16	***
Education	0.29	***	0.30	***
Labour capacity	0.08			
External conditions				
Remoteness	-0.02			
Labour market	0.45	***	0.46	***
Purchasing power	-0.07		-0.09	*
Attitudes				
Attitudes towards wage employment	0.21	***	0.21	***
Attitudes towards self-employment	0.08	*	0.08	*
R^2	0.58		0.58	
N	218		218	

Source: Own calculations with data from SCARLED survey.

Notes: [1)] Model containing all ten input variables. [2)] Model containing only significant variables. [3)] Significance levels of t-Test: * 10%, ** 5%, and *** 1%.

Table A 43: Poland: results for linear regression analysis

	Simulated potential of non-farm diversification			
	Full model[1)]		Reduced model[2)]	
	Standardised coefficient	Significance level[3)]	Standardised coefficient	Significance level[3)]
Need for diversification				
Dependency ratio	0.15	***	0.15	***
Farm size	-0.19	***	-0.19	***
Internal conditions				
Age	-0.02			
Education	0.45	***	0.46	***
Labour capacity	-0.00			
External conditions				
Remoteness	-0.16	***	-0.15	***
Labour market	0.14	***	0.17	***
Purchasing power	0.21	***	0.22	***
Attitudes				
Attitudes towards wage employment	0.27	***	0.28	***
Attitudes towards self-employment	0.07			
R^2	0.65		0.65	
N	199		199	

Source: Own calculations with data from SCARLED survey.

Notes: [1)] Model containing all ten input variables. [2)] Model containing only significant variables. [3)] Significance levels of t-Test: * 10%, ** 5%, and *** 1%.

Table A 44: Romania: results for linear regression analysis

	Simulated potential of non-farm diversification			
	Full model[1)]		Reduced model[2)]	
	Standardised coefficient	Significance level[3)]	Standardised coefficient	Significance level[3)]
Need for diversification				
Dependency ratio	0.12	***	0.10	**
Farm size	-0.04			
Internal conditions				
Age	-0.24	***	-0.26	***
Education	0.17	***	0.17	***
Labour capacity	0.07			
External conditions				
Remoteness	0.02			
Labour market	0.00			
Purchasing power	0.17	***	0.17	***
Attitudes				
Attitudes towards wage employment	0.48	***	0.48	***
Attitudes towards self-employment	0.11	**	0.12	**
R^2	0.75		0.75	
N	224		224	

Source: Own calculations with data from SCARLED survey.

Notes: [1)] Model containing all ten input variables. [2)] Model containing only significant variables. [3)] Significance levels of t-Test: * 10%, ** 5%, and *** 1%.

Table A 45: Slovenia: results for linear regression analysis

	Simulated potential of non-farm diversification			
	Full model[1)]		Reduced model[2)]	
	Standardised coefficient	Significance level[3)]	Standardised coefficient	Significance level[3)]
Need for diversification				
Dependency ratio	0.18	***	0.19	***
Farm size	-0.19	***	-0.20	***
Internal conditions				
Age	-0.02			
Education	0.47	***	0.48	***
Labour capacity	-0.04			
External conditions				
Remoteness	-0.03			
Labour market	0.18	***	0.18	***
Purchasing power	0.11	*	0.12	**
Attitudes				
Attitudes towards wage employment	0.29	***	0.28	***
Attitudes towards self-employment	0.10	*	0.09	*
R^2	0.49		0.50	
N	213		213	

Source: Own calculations with data from SCARLED survey.

Notes: [1)] Model containing all ten input variables. [2)] Model containing only significant variables. [3)] Significance levels of t-Test: * 10%, ** 5%, and *** 1%.

Table A 46: Simulation of future development for the median Slovenian diversifier by choice

	Input variables			Model results	
	Sl (N=151)	Future		Sl (N=151)	Future
Need for diversification			*Need for diversification*		
Dependency ratio	0.50	0.50	unnecessary	0.98	0.98
Farm size	7.13	7.13	necessary	0.00	0.00
Internal conditions			*Internal conditions*		
Age	39.00	60.00	low	0.50	0.50
Education	3.00	3.00	medium	0.00	0.00
Labour capacity	3.00	3.00	high	0.50	0.00
External conditions			*External conditions*		
Remoteness	15.00	15.00	low	0.00	0.31
Labour market	4.00	2.00	medium	0.31	0.69
Purchasing power	84.44	84.44	high	0.69	0.00
Attitudes			*Attitudes*		
Attitudes towards wage employment	4.00	4.00	negative	0.00	0.00
Attitudes towards self-employment	3.00	3.00	positive	0.50	0.50
			Potential of non-farm diversification	0.50	0.15
			low	0.50	0.50
			high	0.50	0.00

Source: Own simulations with data from SCARLED survey.

Table A 47: Simulation of future development for the median Bulgarian past diversifier by choice

	Input variables			Model results	
	BG (N=31)	Future		BG (N=31)	Future
Need for diversification			*Need for diversification*		
Dependency ratio	0.50	0.50	unnecessary	1.00	1.00
Farm size	15.00	15.00	necessary	0.00	0.00
Internal conditions			*Internal conditions*		
Age	46.33	60.00	low	0.00	1.00
Education	4.00	4.00	medium	0.00	0.00
Labour capacity	2.00	2.00	high	0.63	0.00
External conditions			*External conditions*		
Remoteness	60.00	60.00	low	0.57	0.57
Labour market	2.00	2.00	medium	0.00	0.00
Purchasing power	71.25	71.25	high	0.00	0.00
Attitudes			*Attitudes*		
Attitudes towards wage employment	5.00	5.00	negative	0.00	0.00
Attitudes towards self-employment	3.00	3.00	positive	0.50	0.50
			Potential of non-farm diversification	0.15	0.15
			low	0.50	0.50
			high	0.00	0.00

Source: Own simulations with data from SCARLED survey.

Table A 48: Simulation of future development for the median Polish farmer with diversification potential

	Input variables			Model results	
	PL (N=48)	Future		PL (N=48)	Future
Need for diversification			*Need for diversification*		
Dependency ratio	1.00	1.00	unnecessary	0.56	0.56
Farm size	9.81	9.81	necessary	0.44	0.44
Internal conditions			*Internal conditions*		
Age	43.00	60.00	low	0.00	1.00
Education	4.00	4.00	medium	0.00	0.00
Labour capacity	2.00	2.00	high	0.70	0.00
External conditions			*External conditions*		
Remoteness	8.00	8.00	low	0.00	0.00
Labour market	2.00	2.00	medium	1.00	1.00
Purchasing power	106.97	106.97	high	0.00	0.00
Attitudes			*Attitudes*		
Attitudes towards wage employment	4.00	4.00	negative	0.00	0.00
Attitudes towards self-employment	3.00	3.00	positive	0.50	0.50
			Potential of non-farm diversification	0.85	0.48
			low	0.00	0.50
			high	0.50	0.44

Source: Own simulations with data from SCARLED survey.

Table A 49: Simulation of future development for the median Slovenian farmer without diversification potential

	Input variables			Model results	
	Sl (N=12)	Future		Sl (N=12)	Future
Need for diversification			*Need for diversification*		
Dependency ratio	1.00	1.00	unnecessary	0.67	0.67
Farm size	12.50	12.50	necessary	0.00	0.00
Internal conditions			*Internal conditions*		
Age	60.00	60.00	low	0.75	0.75
Education	2.50	2.50	medium	0.00	0.00
Labour capacity	1.75	1.75	high	0.00	0.00
External conditions			*External conditions*		
Remoteness	16.00	16.00	low	0.31	0.31
Labour market	2.50	2.00	medium	0.69	0.69
Purchasing power	84.44	84.44	high	0.25	0.00
Attitudes			*Attitudes*		
Attitudes towards wage employment	2.50	2.50	negative	0.75	0.75
Attitudes towards self-employment	2.00	2.00	positive	0.25	0.25
			Potential of non-farm diversification	0.15	0.15
			low	0.67	0.67
			high	0.00	0.00

Source: Own simulations with data from SCARLED survey.

Table A 50: Simulation of future development for the median Polish diversifier through necessity

	Input variables			Model results	
	PL (N=115)	Future		PL (N=115)	Future
Need for diversification			*Need for diversification*		
Dependency ratio	0.33	0.33	unnecessary	0.16	0.16
Farm size	2.80	2.80	necessary	0.84	0.84
Internal conditions			*Internal conditions*		
Age	39.00	60.00	low	0.00	1.00
Education	4.00	4.00	medium	0.00	0.00
Labour capacity	3.00	3.00	high	0.90	0.00
External conditions			*External conditions*		
Remoteness	8.00	8.00	low	0.25	0.25
Labour market	3.00	2.00	medium	0.50	0.75
Purchasing power	87.40	87.40	high	0.50	0.00
Attitudes			*Attitudes*		
Attitudes towards wage employment	5.00	5.00	negative	0.00	0.00
Attitudes towards self-employment	3.00	3.00	positive	0.50	0.50
			Potential of non-farm diversification	0.68	0.62
			low	0.16	0.25
			high	0.50	0.50

Source: Own simulations with data from SCARLED survey.

Table A 51: Simulation of future development for the median Bulgarian job-starter household

	Input variables			Model results	
	BG (N=37)	Future		BG (N=37)	Future
Need for diversification			*Need for diversification*		
Dependency ratio	0.67	0.67	unnecessary	0.00	0.00
Farm size	1.20	1.20	necessary	0.77	0.77
Internal conditions			*Internal conditions*		
Age	43.00	60.00	low	0.00	1.00
Education	4.00	4.00	medium	0.00	0.00
Labour capacity	2.00	2.00	high	0.70	0.00
External conditions			*External conditions*		
Remoteness	45.00	45.00	low	0.50	0.50
Labour market	3.00	2.00	medium	0.50	0.50
Purchasing power	80.04	80.04	high	0.50	0.00
Attitudes			*Attitudes*		
Attitudes towards wage employment	5.00	5.00	negative	0.00	0.00
Attitudes towards self-employment	3.00	3.00	positive	0.50	0.50
			Potential of non-farm diversification	0.85	0.50
			low	0.00	0.50
			high	0.50	0.50

Source: Own simulations with data from SCARLED survey.

Symbols and abbreviations for the model

g(k)	value for intermediate variable γ(k)
i	name of input variable, i={dep_ratio, farm_size, age, education, lab_cap, remoteness, lab_market, purchasing, self_att, wage_att}
j	name of output variable, j={potential}
k	name of intermediate variable, k={necessity, internal, external, attitudes}
l	name of control function, l={potential, necessity, internal, external, attitudes}
M(i), M(j)	set of membership functions for input variable ξ(i) and for output variable υ(j)
n(i), n(j)	number of fuzzy subsets for input variable ξ(i) and output variable υ(j)
q, r, s	definition points in membership functions
T(i), T(j), T(k)	set of linguistic terms for the fuzzy subsets of input variable ξ(i), output variable υ(j), and intermediate variable γ(k)
X(i)	co-domain for input variable ξ(i)
x(i)	value for input variable ξ(i)
Y(j)	co-domain for output variable υ(j)
y(j)	value for output variable υ(j)
γ(k)	intermediate variable
Γ(k)	set of input variables
$\mu_{\tau(i)}(x(i))$, $\mu_{\tau(j)}(y(j))$	membership degree for value x(i) in fuzzy subset τ(i) and value y(j) in fuzzy subset τ(j)
Ξ	set of factors that determines farm households potential to diversify into non-farm income activities
ξ(i)	input variable i
τ(i), τ(j), τ(k)	name of fuzzy subsets for input variable ξ(i), output variable υ(j), and intermediate variable γ(k)
Y	set of output variables
υ(j)	output variable
φ(l)	control function, l={necessity, internal, external, attitudes, potential}

age	age
attitudes	attitudes towards employment alternatives
dep_ratio	dependency ratio
education	educational level
external	external conditions
farm_size	farm size
internal	internal conditions
lab_cap	household's labour capacity
lab_market	labour market conditions
necessity	need for diversification

potential	individual household's potential for non-farm income diversification
purchasing	regional purchasing power
remoteness	remoteness
self_att	attitudes towards non-farm self-employment
wage_att	attitudes towards wage employment

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