The Role of Inter-Organisational Relations and Networks in Agribusiness: The Case for the Polish Fruit and Vegetable Industry

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ABSTRACT

This paper contributes to the ongoing discussions on the benefits of inter-organisational networks (IONs) in agribusiness. It is based on the field of inter-organisational relations (IORs) and network approaches that are applied in the framework of the Activities-Resources-Actors (ARA) model. The aim of this paper is to recognise and evaluate the distinguishing features of network relationships, which lead to better defined networks in agribusiness. Polish fruit and vegetable producers, processors and traders were investigated in this study. The study reveals that the main objectives of network relationships are to increase profits, this is linked to the optimisation of supplies and provisions, the building of communities and relationships and sustainable development. The outcomes of network relationships have been recognised as the non-transactional exchange of knowledge and information, mutual adaptations, adjustments and standardisations. They are led by strong transactional relationships in the supply chain, which are based on pricing conditions, terms of payments, formal contracts and cooperation. This study distinguishes five categories of inter-organisational network relationships they are: very strong operational, strong sustainable, moderate social, weak innovative and very weak shared resources. The paper concludes that the studied networks are characterised by strong activity and actor ties and weak resources bonds. Specifically the lack of shared resources might negatively influence the networks innovation and sustainability in the future.

Keywords: inter-organisational network relationship; network approach; agribusiness network; fruit and vegetable processing industry.

1   Introduction

The study of IONs is a relatively new research field in economics. It is important to understand it's meaining in all areas of economic activity. In relation to agribusiness economics, network analyses must take into account current changes and specify any new research scope. An increasing number of authors indicate that the complete agribusiness sector can, and should, be viewed as a business network. Common coordination between vertical and horizontal participants within agribusiness, as well as evolving alternative governance structures, provides a basis for applying a network approach which takes into account the connections and interactions between the parties forming agribusinesses (Wiśniewska-Paluszak, 2017; Gazdecki, 2018).

Agribusiness networks can be recognised as a variety of social, professional and exchange relationships between enterprises with their suppliers, customers, competitors, or other individuals. This can occur inside and outside their normal area of activity and country. The basis of the network is the concept of 'collective actor' and therefore the existence of collective actions (Sauvée, 2002).

IONs have been widely discussed in academic literature, but there are less research articles on defining network relationships in agribusiness. Relationships are primarily recognised within traditional forms of cooperation including contract farming, farm cooperatives, farm producers groups, food supply and value chains, strategic alliances or clusters focusing mostly on collaborative requirements in a specific social or business context.

There are some well recognised definitions of network relationships in economics that have not been applied to agribusiness research. Some of these highlight that networks consist of contractual and/or non-contractual, long-lasting business relationships, and formal and/or informal social relationships that influence the decisions on activities and resources of network actors. Most general definitions highlight that a network is an example of a proactive and voluntary community formed at least by two parties for their mutual benefit. They specify which party is going to undertake which activity, and how the parties are going to work together to achieve their goals and the goals of the network. To improve our knowledge of network relationships in agribusiness existing definitions of networks should be taken into account.

A gap in the academic literature has been found in regard to the theoretical formalisation, as well as empirical exploration, of network relationships in agribusiness. The need to recognise the elementary objectives and functions of network relationships in agribusiness has been identified. This study answers the question raised about the status of network relationships in agribusiness. The aim of the paper is to identify and evaluate the distinguishing features of network relationships, which lead to better defined networks in agribusiness.

2   The applications of inter-organisational relationships (IORs) and network approaches

Despite the huge and rising popularity of IORs and networks there are still no commonly agreed sets of criteria to differentiate them. The criteria are mostly associated with conflicitng ideas that describe IORs and networks that are difficult to explore in practice. The situation is a result of the diversity of relationship attributes which characterise the nature of networks (Table 1).

The field of IORs was intensively researched in the 1990s, when ION theories as well as relational models of business/industry were developed by various scientists including Powell (1990), Grandori and Soda (1995), Ebers, (1997), and Dyer and Singh (1998). Most authors discussed the distinctive features of IORs including complementary strengths, relational means of communication, conflict resolutions within norms of reciprocity and reputational concerns, commitment among parties, climate of mutual benefits, or interdependent actor preferences and choices (Powell, 1990).

An exclusively named 'network approach' was initiated by Håkansson and Snehota (1989). The authors presented the network model as a continuous interaction between business parties. They based their concept on extensive empirical studies of industrial markets conducted in the 1970s and 1980s. These studies indicated the existence of business relationships in the markets and the interdependence among these relationships.

Table 1.
Attributes of network relationships.

Network			
	Links	Regulations	Objectives and Functions
Attributes	continuity importance complexity interdependency reciprocity formal informal	lack of domination non-shareholding non-traditional communicative cooperative coordinative specific alternative non-holding non-capital contractual quasi-organisational quasi-integrative non-subjective	common aims individual aims functional frames synergic potential permanent interactions externalities economic structures dedicated lack of exclusivity

Source: Wiśniewska-Paluszak, 2018.

As a result existing forms of networks, and the organisational mechanisms that support them have been recognised. The networks and mechanisms include: industrial networks, uncertainty and frequency of transactions, measurability of performance and controlling, differentiation and complementarity, intensity of interdependence, number of units, complexity of interdependent activities, asymmetry in the resources controlled, communication, decision and negotiation mechanisms and social coordination (Grandori and Soda, 1995).

However, it is worth highlighting that at that time it was indicated that the specificity of relational appearances of IORs differentiates them from hierarchical relations, which are typical of company structures, and from competitive relations which are normal for market structures. The most common method of notional systematisation was to indicate the characteristics distinguishing IORs from non-economic networks, and from other non-network forms of economic activity. A useful example for the categorisation of an IOR is to distinguish it's characteristics from other economic institutions, markets or firms, and considered characteristics including: distribution of property rights over resources, resource flows among actors, mutual expectations among actors with regard to relationship, information flows among actors and main coordination mechanisms. The ideal characterisation for an IOR is presented in Table 2.

Table 2.
Ideal characterisation of an inter-organisational network.

Distribution of Property Rights	Resource Flows among Actors	Mutual Expectations	Information Flows	Main Coordination Mechanisms
unilateral decision control and residual risk bearing combined with periodical joint decision making by transaction partners	repeated partner-specific exchange of resources	contractually unspecified reciprocal obligations and mutual expectations longer term social relationship finite duration (based on goal accomplishment) or unspecified duration	higher degree of information sharing with regard to a wider spectrum of information	negotiation and agreement

Source: own elaboration on Ebers, 1997.

Finally these models discuss the foundations of mutual benefits including: investment in relation-specific assets, substantial knowledge exchange including joint learning, combining complementary but scarce resources or capabilities and the lowering of transactional costs (Dyer and Singh, 1998).

As stated by Håkansson and Snehota (1995) the interactions develop into progressive relationships with features that are specific for individual businesses involved. Two main groups of characteristics for business relationships have been distinguished, the structural characteristics including: continuity, complexity, symmetry and informality, and the process characteristics including: adaptations, cooperation, conflict, social interaction and routinisation. Typical business relationships appear symmetrical in terms of resources and initiatives for the parties involved and they often have a low level of formalisation. Mutual adjustments are the requirmenets for the development and continued existence of relationships between two companies. Elements of cooperation and conflict always coexist in business relationships. Even though business relationships are fundamentally about business, the specific behaviours, subjective values, and the personal bonds and convictions of the individuals involved play an important role in the formation of business relationships.

The enormous complexity and heterogeneity of the field of IORs and networks research has been highlighted by synopsis in a literature review (Oliver, Ebers, 1998). The authors denoted seven parts and 77 categories of IORs. They analysed the body of literature according to names and indicated variables appearances. It is worth noting that some of the results refer to the variables and names with the highest mentions: theories (resource dependence 27.8%), methods (empirical 89%), inter-organisational ties (multiple 62%), levels of analysis (organisational 78.5%), antecedents (immaterial resources 65.2%), processes (motivation and intention 65.2%) and outcomes (power/control 31%).

The interest in networks is concerned with understanding the content and shape of business relationships. The main events observed in business networks and interactions include: relationships, cooperation, interaction, exchange, association, relatedness and competition (Håkansson and Ford, 2002; Ford and Håkansson, 2006).

Håkansson and Snehota (2006) expanded on their earlier conclusions by highlighting the importance of combining various types of resources across company boundaries in order to create positive economic outcomes. They also highlighted that business relationships play a central role because they can determine how individual resources are used and combined between businesses. Therefore, they stated that the effectiveness of an individual business is determined by its organised relationships to other businesses. The authors highlighted the major role that mutual communication and collective actions have on business networks. Most of the studies mentioned are aimed at increasing our understanding of the character, pattern, origins, rationale and importance of IORs. They focus on the properties and overall pattern of relationships between the organisations that are exploring a mutual interest in networks. Organisations remain independent and autonomous, retaining their separate interests. The aim for all researchers is to understand and explain one or more of the origins, content, patterns, forms, processes, management or outcomes of relations between or among organisations. Theoretical approaches in research create their own distinctive frames of enquiry from two core building blocks, either a set of dimensions describing related organisations or a set of dimensions describing the relationship that links them (Cropper et al., 2008).

According to the network approach, as identified by the Scandinavian model, the third building block of IORs is a set of dimensions describing related resources (Håkansson et al., 2009). A formal model combining all three dimensions may assist in the classification and recognition of IONs relationships. This three-dimensional theory describes network structures in three layers:

- the activities layer is related to the links between the activities of two actors including: production, logistics, administration, deliveries and information handling
- the resources layer is related to how actors' resources may become adapted and linked together including: tangible (plant or equipment) and intangible (knowledge) which are especially important in the innovation process
- the actors layer is related to interpersonal links that are developed between individuals in the parties involved including: the degree to which individuals see, know and feel close to each other; how they trust, appreciate and influence each other and how they may become mutually committed.

This model provides a theoretical framework for the systematic description of the processes and outcomes of networks. Since the model is only theoretical, the authors have not provided a definitive group of network attributes, it should ony be used as a theoretical framework for operational variables of activity structure, links and patterns within the network. More research is required into the application of IONs and their effect in agribusiness. Studies on IORs and networks have already been conducted in the agribusiness sector by Volpentesta and Ammirato (2008), Scuderi and Sturiale (2014), Rapisarda et. al

(2015), Sergaki (2010), Mackle et. al. (2013), and Tepic et. al (2012). The studies show not only an increasing academic interest in agribusiness networks, but also their increasing role as a type of activity in agribusiness. They describe some important characteristics of agribusiness networks, ensuring food safety both in terms of quantity and quality, that occur at different stages of production, processing, storage and distribution. Up-to-date studies of these highlight some important components of agribusiness networks in contemporary contexts, they include:

- innovativeness and open innovation (Perdomo et al., 2017; Abdirahman et al., 2014; Omta et al., 2014; Kühne et al., 2012; Gellynck et al., 2007; Omta, 2002)
- food supply chains (Forbes et al., 2010; Malak-Rawlikowska and Milczarek-Andrzejewska, 2016; Clemente et al., 2016; Lie and Rich, 2016; Nasuelli et al., 2015; Fisher and Hartmann, 2010, Gazdecki and Szakály, 2018)
- social capital and relationships (Lefebvre et al., 2012; Wilson, 2007; Kühne et al., 2013; Gërdoçi et al., 2016)
- decision making within the alternative governance structures (Ménard, 2000; Ménard and Klein, 2004; Sauvée, 2001; Sauvée, 2002; Zylbersztajn, 2010)
- sustainability and sustainable development (Abdirahman and Sauvée, 2014; Posch, 2010; Livesey et al., 2009)
- bio-economy and bio-business (Nuhoff-Isakhanyam et al., 2016; Nuhoff-Isakhanyam et al., 2017).

Most of the authors recognise the prominent role that agribusiness networks play in the modern economy. Further studies into the objectives and functions, including other attributes, of IORs in agribusiness is required. The main hypothesis of this paper is that network relationships have distinguishing and complex attributes that are highly dependent on the network's objectives. This may lead to the definition and categorisation of agribusiness networks. This study applies the mentioned IORs and the ARA concepts to the operationalisation of agribusiness network relationships, dimensions, attributes and categories.

3 Selection of research sample and methods

Business networks are not easy to identify, most current researchers use case or ground studies for research techniques (Bizzi and Langley, 2012). Most authors identified the major challenges of using case studies for a network researcher as: the problem of network boundaries, complexity, time and case comparisons (Halien and Törnroos, 2005). However, case and ground studies are capable of generating a robust, comprehensive array of knowledge about complex, highly interdependent and dynamic economic and social phenomena (Sterns et al., 1998).

The data for this study was collected using a questionnaire that was carried out in October 2017. We used purposive (selective) sampling, also know as typical case sampling. We selected non-probability samples based on the characteristics of the population and the objective of the study. It was aimed at the most representative sample for the surveyed sector. The main criteria for sample selection were the businesses profile and size, and includes representatives from all stages of supply chain. A sample of 20 businesses was selected, but two refused to respond to the questionnaire, so the results are based on replies from 18 businesses. The businesses included three producers, three processors, seven retailers and five wholesalers. Most of the selected businesses are microenterprises (with between one and nine full-time employees), one is small enterprise (with between 10 and 49 full-time employees) and one is a medium size enterprise (with between 50 and 249 full-time employees). The size of the sample should not be considered as the being representative of the general population.

This study focuses on businesses that produce, process and sell fruit and vegetable products. This sector was selected for several reasons; fruit and vegetable products are an important part of agri-food production in Poland, it also plays a major role in ensuring food security and nutrition for a wide segment of the population. Domestic and export markets are regarded as having increased value and rising awareness from consumers (Wiśniewska, 2012). The fruit and vegetable industry can be regarded as typical of the agribusiness sector, it has distinctive production features, and the supply chain is linked to it's natural, technical and infrastructural requirements. It requires supply chain integration and strong business relationships within the supply and value chains. The businesses within the sector have various structures, but most of them are micro-businesses, and fewer are small and medium sized enterprises. The diversity of the actors and the intensity of interactions beween them are beneficial to the development of a variety of relationships between them.

The main aim of the questionnaire was to identify the most significant characterstics of network

relationships within the dimensions of their objectives and functions, regulations, origins and outcomes. These dimensions and categories were selected as the most often used in academic literature. The respondents evaluated the significance of all 25 attributes together. In the questionnaire the five-level Likert scale was used to measure the significance of each attribute: five - very important, four - important, three – neutral, two – less important, one – unimportant.

The results were evaluated using relational values. First the numbers of ranks were related to the total numbers of ranks for each question, in this way the significance of each attribute of the studied element was expressed. The first relative measure of the percentage share of each rank in total ranks was also studied, this measure was used to compare the significance of the answers at each level for each question, and the dimensional graphs representing the outcomes of attribute ranking were plotted.

The ρ-Spearman's ordinal correlation coefficient has been estimated to define network relationships (1). The calculation of rank correlation was tested with the independence t-test of ρ-Spearman (2). To assess the correlation between variables the following scale has been used: strong from 1.0 to 0.61, medium from 0.6 to 0.31, weak from 0.3 to 0.00 (Sobczyk, 2007, p. 118).

$$\rho = 1 - \frac{6\sum_{i=1}^{n} d_i^2}{n(n^2 - 1)}, \qquad (1)$$

where, di = rank difference of converted values of variables xi, yi (i = 1, 2, …, n) (Kenkel, 1984, p. 754; Sobczyk, 2007, pp. 117-118).

$$t = \rho \sqrt{\frac{n-2}{1-\rho^2}}, \qquad (2)$$

where, n = number of observations (Gajek and Kałuszka, 2000, p. 118; Kenkel, 1984, p. 754; Sobczyk, 2010, p. 284).

The level of probability has been evaluated with the p-value. In this research it is the probability (assuming H0) of a test statistical value equal to actually observed value. Very small p-values indicate strong conclusive evidence for rejecting the null hypothesis (H0) and support the research hypothesis (H1). We assumed that:

$$\text{H0: } \rho \leq 0 \qquad (3)$$

$$\text{H1: } \rho > 0 \qquad (4)$$

The p-value is called the attained significance level of a statistical test. Statistical significance implies only that a null hypothesis can be rejected with a specified low risk of error (Hildebrand and Ott, 1996, p. 260-263). The 95% confidence interval has been assumed for the research population. Confidence intervals express that allowance for error (Hildebrand and Ott, 1996, p.226). All the statistical measures were computed on Statistica ver. 13.1. software.

Finally two relative measures were calculated and compared. The ratio of positive responses (very important and important) to total responses and the ratio of negative responses (less important and unimportant) to positive responses. The first measure indicates a high significance of the measured attribute and a low significance of the second one. These measures directed the ranking of all attributes according to their significance. The ranking graph representing the outcomes of attribute significance was plotted and impact sections were denoted.

Grouping the outcomes in the theoretical framework of network approach was the final stage of the study. The relatively ordered attributes led to the delimitation of network categories. On the significance of ordered attributes, network categories were named. The coherence of delimitated categories was confirmed by descriptive measures including mean, standard deviation, coefficient of variation and maximum and minimum values, as shown in Table 4. The significance of the network layers was also evaluated and confirmed by the same descriptive measures.

4   Research results

The aim of the questionnaire was to identify IORs and networks, and their features, in the fruit and vegetable industry in Poland. The sample businesses indicated that they have primary relationships with 1,566 contractors, including 1,124 suppliers and 442 buyers. On average it takes 62 suppliers and 25 buyers to form a network. The relationships are developed over a range of regions and countires. The businesses studied mainly cooperate with regional suppliers. 63% of their suppliers are located in the same region as their business, 35% of their suppliers are located in the same country but in a different region and only 10% of their suppliers are located in other European countires.

The length of relationships varies for suppliers and buyers, and it is common for individual businesses to cooperate with their suppliers for several months. 81% of businesses stated that their relationships with suppliers lasted for several months, 37% of them stated the same for the relationships with buyers. Only 6% of them stated that relationships with suppliers lasted between one and five years, A similar figure (7%) is stated for relationships with suppliers lasting between six and ten years and those lasting over ten years. For the buyers the same relationships were 30% for those lasting several months, 20% for those lasting from one to five years and 13% for those lasting over ten years.

42% of businesses declared that their cooperation with suppliers is based on trust, and 23% of businesses stated the same for their cooperation with buyers. 15% of busiesses declared that mutual, dependence based relationships with suppliers and buyers is important. 6% of businesses declared that they investigate the possibility of future cooperation with suppliers and 12% declared the same when investigating future cooperation with buyers. Some businesses have different objectives from their suppliers and buyers. Finally, some businesses terminate relationships with existing suppliers and buyers, in order to establish new relationships with different buyers and suppliers.

77% of respondents also declared that they knew their sub-contractors. Half of the respondents indicated that they are not in secondary relationships with sub-contractors, and 40% indicated that they have relationships with their sub-contractors. 40% of the respondents think that they would maintain the secondary relationships if they lose their primary relationships. But 10% believe that they will lose the secondary relationships if the primary relationship was lost.

Respondents also stated that they have secondary relationships with competitors of their suppliers. 85% of respondents declared that they know the competitors of their suppliers. 50% of respondents declared that they also have relationships with the competitors of their suppliers, 30% of respondents declared they do not have relationships with competitors of their suppliers. 30% of respondents think that they will continue their relationships with the competitors of their suppliers if they break off the relationships with suppliers and 30% of respondents think that they will not continue their relationships with competitors of their suppliers if they break off the relationships with the suppliers.
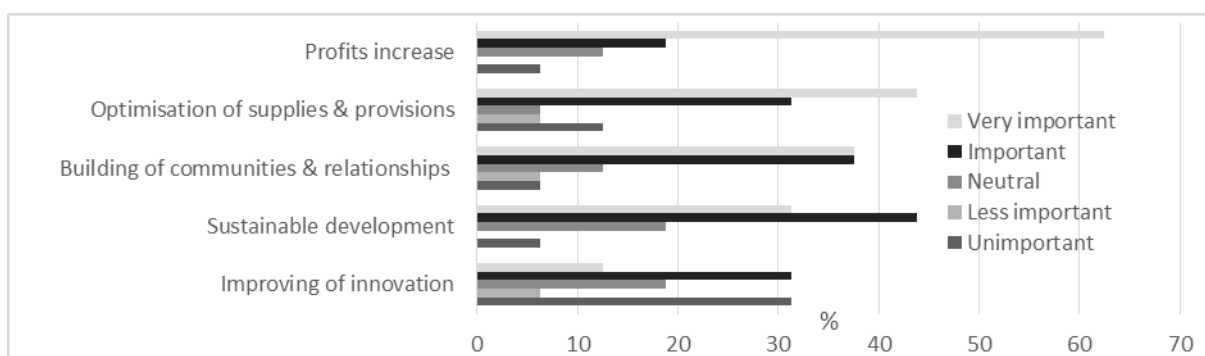

Figure 1. The objectives and functions of network relationships of the Polish fruit and vegetable industry enterprises (n=18, in %). Source: own calculation based on data from questionnaire carried out in October 2017.

The questionnaire tried to identify how important the different objectives and functions are in network relationships (Fig 1). Respondents indicated that the most important objective of a network is to increase profits (63%). The second objective was optimisation of supplies and provisions (44%) and the third was

building the communities and relationships (38%). It is worth noting that one third of the respondents indicated that sustainable development is the most important purpose and that this objective is also an important one (44%). From all of the positive answers it can be seen that the building of communities and relationships, as well as sustainable development, are both as equally important as the optimisation of supplies and provisions (75%). However the increase in profits was ranked the highest for positive responses (81%). The least important purpose was improving innovation, only 44% of responses were positive and almost 38% of responses were negative, with 19% as neutral.
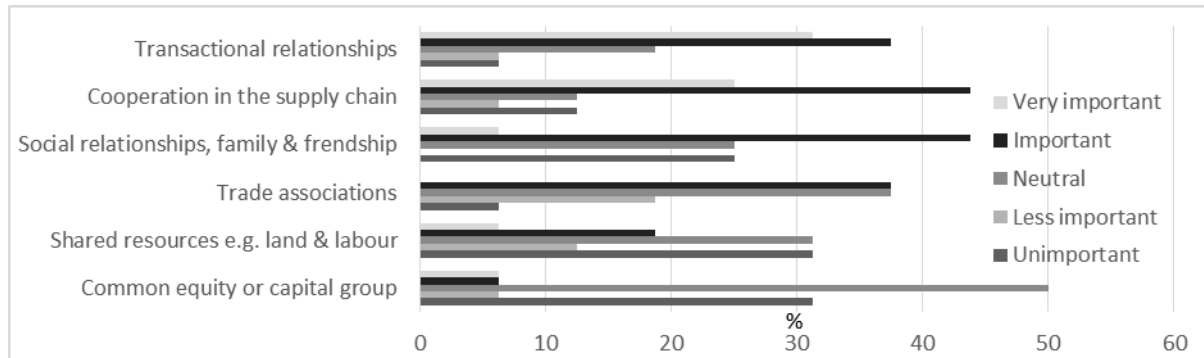

Figure 2. The regulations of network relationships the Polish fruit and vegetable industry enterprises (n=18, in %).
Source: own calculation based on data from questionnaire carried out in October 2017.

The questionnaire also attempted to identify the importance of diverse regulations in network relationships (Fig. 2). The respondents indicated that the most important relationships are transactional relationships (31%). The second, ranked as very important, was cooperation in the supply chain (25%). When positive responses are compiled it can be seen that they were ranked equally importantly by the respondents (69%). The measure for social relationships, family and friendship is 50% which means that social networks are also important for the studied businesses. The relationships for forms of trade associations reached 38% of positive responses. The least important regulations for networks in the studied businesses were shared resources e.g. land, labour and common equity or capital groups. It is worth noting that the sum of negative and neutral responses for this form of networks were high and reached 44%, 37%, 31%, and 50% respectively.
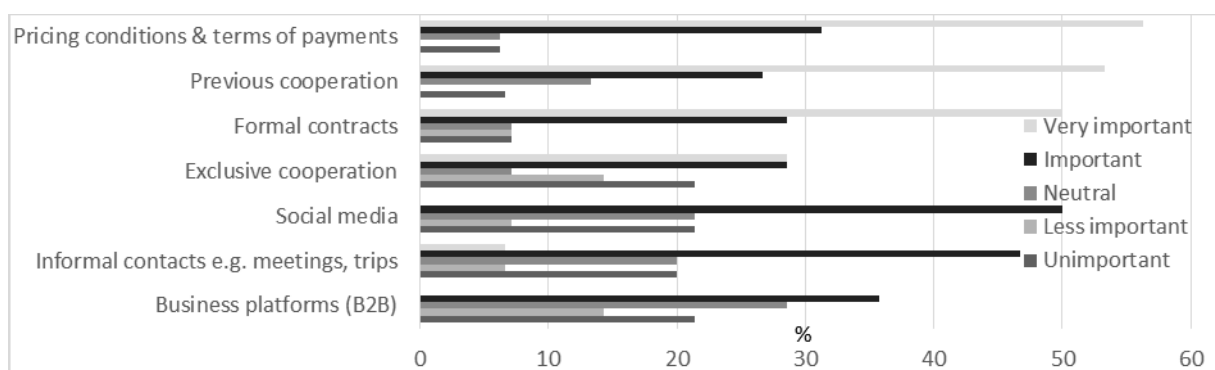

Figure 3. The network origins of the Polish fruit and vegetable industry enterprises (n=18, in %).
Source: own calculation based on data from questionnaire carried out in October 2017.

The questionaire challenged the importance of different network origins (Fig. 3). The respondents indicated as the most important origins pricing conditions and terms of payments (56%). The next, ranked as very important, was previous cooperation (53%) and the third was formal contracts (50%). It can be seen from the positive responses that these three items were the highest ranked i.e. 88%, 80% and 79% respectively. Exclusive cooperation, social media and informal contacts (meetings, trips) were indicated by

more than 50% of the respondents as being important and very important i.e. 57%, 50% and 53% respectively. Positive responses for business platforms (B2B) were 36% and the same percentage of respondents indicated that it was less important or not important. Almost the same percentage of negative responses (less important and not important) was indicated for exclusive cooperation (36%), informal contacts (29%) and social media (27%).
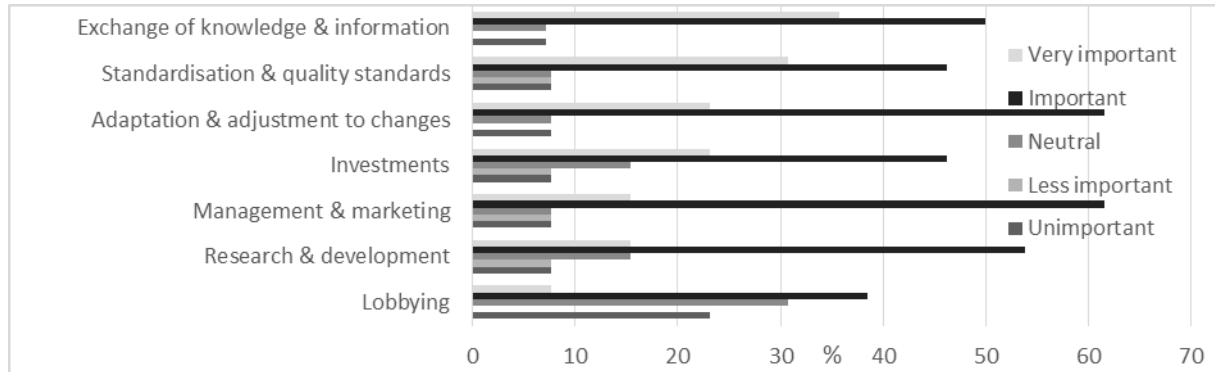

Figure 4. The network outcomes of the Polish fruit and vegetable industry enterprises (n=18, in %).
Source: own calculation based on data from questionnaire carried out in October 2017.

The next stage of the questionnare was to identify the importance of different network outcomes (Fig. 4). Over one third of the respondents pointed out that the most important network outcome was the exchange of knowledge and information (36%). The next was standardisation and quality standards (31%). Adaptation and adjustment to changes, as well as investments, were identified as very important outcomes by 23% of respondents. Management and marketing, as well as research and development were identified as very important only by 15% of respondents. It can be seen from the sum of positive responses that exchange of knowledge and information is still highest (86%), the next were adaptations and adjustments to changes (85%), while standardisation and quality standards were ranked third equally with management and marketing (77%). Investment, as well as research and development, was ranked positively by more than 50% of respondents i.e. 69%, 69% and 62% respectively. Lobbying was of less importance for the analysed business relationships (46%), it is worth noting that for 23% of respondents this was unimportant.

5   Discussion

This paper intends to identify and evaluate interdependencies of the objectives of networking, as well as categorising network relationships of businesses questioned in accordance with the IORs and ARA model.

The interdependencies between the different objectives of the network and relationships between the studied businesses are also discussed. To identify the interdependencies the correlation measures described in the methods section have been used. The analysis of interdependencies shows that the building of communities and relationships is the most interdependent variable. It shows the highest degree of correlation along with optimisation of supplies and provisions (0.852). This is verified by a very high level of significance p=0.00007. It also shows a strong interdependence with an increase in profits (0.789), and sustainable development (0.749). These interdependencies are also verified with a very high level of significance; p=0.0001 and p=0.00035 respectively (Table 3).

Communities and relationships are built for the optimisation of supplies and provisions, sustainable business and increasing profits. Therefore, sustainable development is highly correlated with the optimisation of supplies and provisions (0.721), as well as profits increase (0.707). Both are verified with a very high level of significance; p=0.00073 and p=0.001042 respectively. It is very interesting that sustainable development and profits increase are recognised by the businesses questioned as not conflicting the objectives of networking.

We can conclude that the results indicate that the specific nature of the fruit and vegetable industry in Poland requires combined objectives for sustainable network relationships, i.e. sustainable development and profits increase.

The second factor for increased profits in the studied businesses is optimisation of supplies and provisions. This correlation coefficient is also high (0.680), verified by p=0.01913. This results from industry specificity, which is the processing and distribution of fast-moving consumer goods.

Targeting an increase in profits shows the lowest correlation alongside improving innovation (0.573). This is verified at the significance level p=0.012982. It confirms that the businesses questioned are moderately aware of the connection between the two aims. Innovation has probably been seen to require high inputs, and is connected with lower profits for a considerable length of time. Alternatively members of the fruit and vegetable industry are too small to improve innovation individually (Wiśniewska, 2012). It is possible that they are aware that in the long-term, indirectly building communities and relationships leads to collective innovation (0.477). The optimisation of supplies and provisions (0.376) is moderately perceived as being connected with improving innovation. This is verified by the high level of significance at p=0.04557 and by the low level of significance at p=0.123757. The businesses questioned weakly recognise the connection between sustainable development (0.324) and improving innovation at a low level of significance p=0.190131. Therefore, independence of tested hypothesis is not out of the question.

We have five objectives as variables, two of the variables were correlated, therefore ten correlations have been tested null hypothesis (H_0) and the research hypothesis (H_1).We assume that:

H_0 means there is no dependency between two variables

H_1 means there is dependency between two variables.

It can be seen from the correlation measures that for a 95% of confidence interval we can reject the null hypothesis (H_0) for almost all ρ- Spearman's coefficients. Eight out of ten calculated coefficients have been verified positively at p<0.05. For the other two the null hypothesis (H_0) have not been rejected at p<0.05. In these two cases the p-value should be greater than 0.05 to support the research hypothesis (H_1).

These two cases involve correlation between improving innovation and the optimisation of supplies and provisions. The p<0.13 and correlation between improving innovation and sustainable development is p<0.2.

Five of the 25 observed network attributes received very strong positive responses. They are: pricing conditions and terms of payments, exchange of knowledge and information, adaptation and adjustment to changes, profits increase and previous cooperation. In the questionnaire they received 80% or above of the positive responses, and the ratio of negative to positive responses for these attributes is less than 10%. These attributes were very strongly accepted by the questioned respondents in their business network relationships. They are the foundations of very strong network relationships (Fig. 5).

Table 3.
The interdependence of networking objectives in the Polish fruit and vegetable industry enterprises (ρ- Spearman's ordinal correlation coefficient, n=18).

Variables	Improving Innovation	Optimisation of Supplies & Provisions	Building of Communities & Relationships	Sustainable Development	Profits Increase
Improving Innovation	1	0.376 *t=1.624712* *p=0.123757* *p<0.13*	0.477 *t=2.168298* *p=0.04557* *p<0.05*	0.324 *t=1.368288* *p=0.190131* *p<0.2*	0.573 *t=2.794702* *p=0.012982* *p<0.05*
Optimisation of Supplies & Provisions	X	1	0.852 *t=6.504859* *p=0.00007* *p<0.05*	0.721 *t=4.162485* *p=0.00073* *p<0.05*	0.680 *t=3.70723* *p=0.01913* *p<0.05*
Building Communities & Relationships	X	x	1	0.749 *t=4.524608* *p=0.00035* *p<0.05*	0.789 *t=5.129773* *p=0.0001* *p<0.05*
Sustainable Development	X	x	x	1	0.707 *t=3.995628* *p=0.001042* *p<0.05*
Profits increase	X	x	x	x	1

Source: own calculation based on data from questionnaire carried out in October 2017.

In this group of very strong network attributes the activities level consists of exchange of knowledge and information alongside adaptation and adjustment to changes. The resources level relates mostly to non-material resources which are recognised as knowledge and information, and are exchanged operationally. The actors level can be described by previous cooperation, alongside good pricing conditions and terms of payment. This group of very strongly accepted network attributes can be categorised as an operational network.

The second group can also be distinguished by strong network attributes. The group consists of ten attributes, which received between 79% and 69% of positive responses, and the ratio of negative to positive responses was between 10% and 20%. The group is composed of three network objectives: optimisation of supplies and provisions, building of communities and relationships and sustainable development. One network origins dimension was identified as formal contracts, and two attributes representing regulations dimension of business relationships, transactional relationships and cooperation in the supply chain were also identified. In this group four different network outcomes are recognised, they are: standardisation and implementation of quality standards, management and marketing, research and development and investments. The attributes collected in this group are strongly accepted by the respondents in their networks. According to the attributes studied businesses undertake extra non-transactional activities with their business partners in order to optimise supplies and provisions, build communities and relationships and build sustainable development.

In the activities layer management and marketing, cooperation in the supply chain and standardisation and implementation of quality standards are distinguished. In this group we could distinguish the resources layer which is connected to investments and research and development. In the actors layer transactional relationships and formal contracts are distinguished. This group of strongly accepted network attributes can be categorised as a sustainable network.

The group of moderate network attributes consists of five items for which the ratio of positive to total responses was between 50% and 60%, and the ratio of negative to positive responses was over 50%. This means that attributes collected in this group were negatively recognised by a large number of respondents. The moderate group consists of origins dimension attributes including exclusive cooperation, informal contacts (meetings and trips) and social media. The regulations dimension of relationships in this group consists of social relationships, family and friendship. The attributes identified by this group are moderately accepted by the respondents in their networks. In the moderate networks studied, businesses undertake extra non-transactional activities with their business partners in order to develop social relationships.

The activities layer is composed from exclusive cooperation and lobbying. In this group we can also distinguish the resources layer which is similar to the previous group of non-material assets. This time these assets are social relationships, family and friendships. In the actors layer informal contacts e.g. meetings, trips, and social media can be distinguished. This group of moderate attributes can be categorised as a social network.

The group of weak attributes is composed of five items for which the ratio of positive to total responses was quite low, between 30% and 40%, and the ratio of negative to positive responses was also quite high, between 80% and 100%. This means that the attributes collected in this group were more often negatively recognised. The attributes collected in this group are weakly accepted by the respondents in their network relationships. In this weak network a few studied businesses undertake extra non-transactional activities with their business partners in order to improve innovation. They network in trade associations and business to business platforms (B2B).

In the activities layer improving innovation can be seen. In this group we can indirectly distinguish the resources layer as innovative and trade relationships, they are of a similar non-material nature. In the actors layer trade associations and B2B platforms (B2B) can be seen. This group of weak attributes could be categorised as an innovative network.

Finally the last group of very weak attributes can be specified. It consists of only two attributes, but they are recognised in the literature as very important for business networks. They are shared resources e.g. land, labour and common equity or capital group. However, they are both negatively recognised by the businesses questioned. Between 10% and 30% of the respondents indicated that they are very important or important in their business relationships. The negative recognition of these attributes was very high. The ratio of negative to positive responses varied from 3:1 (300%) - 2:1 (200%).
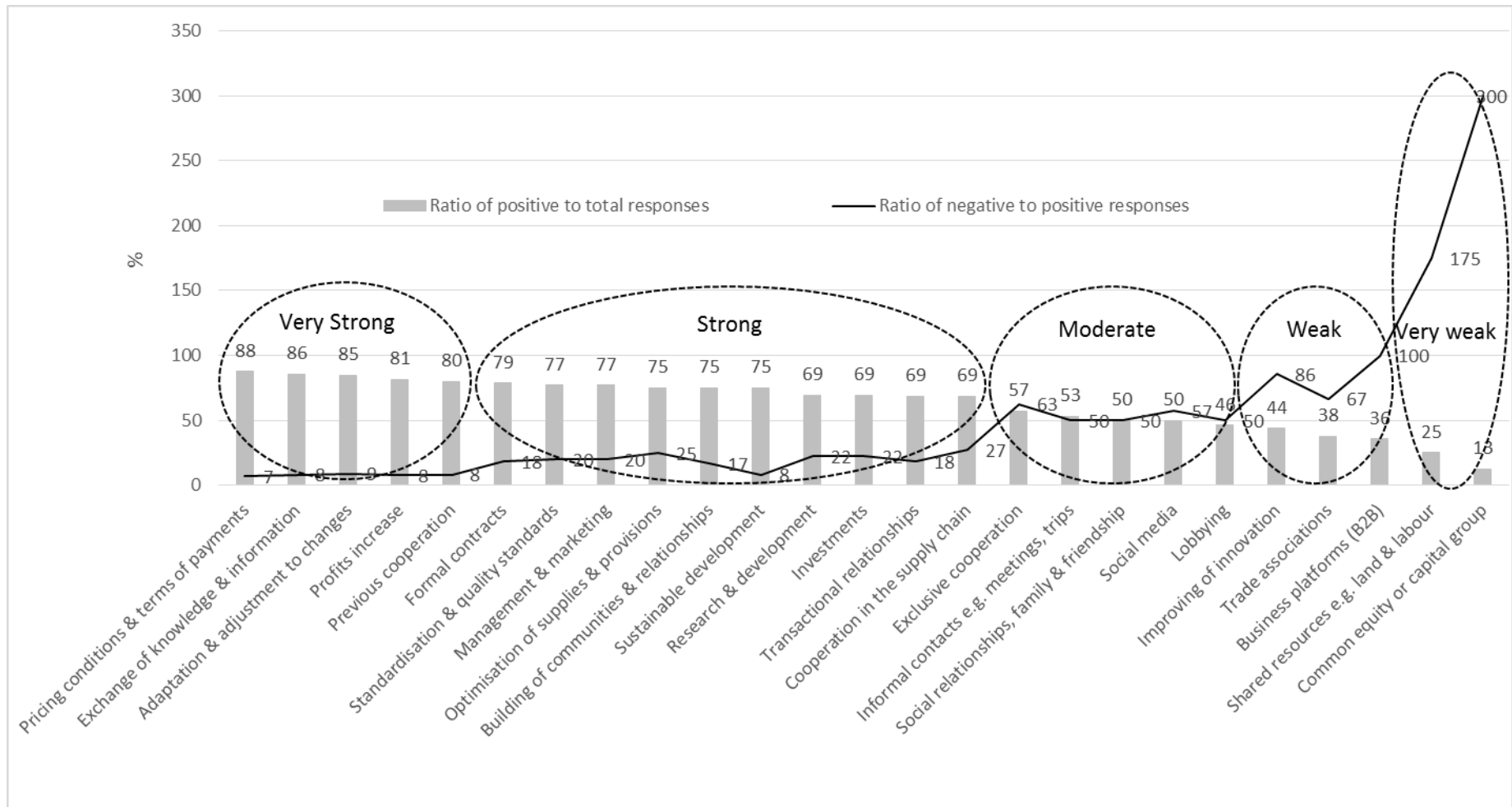
Figure 5. The inter-organisational network attributes in the Polish fruit and vegetable industry enterprises (n=18, in %).
Source: own elaboration based on data from questionnaire carried out in October 2017.

Table 4.
Matrix of categorisation of inter-organisational network relations in the ARA model

Network Layer/ Category	Activities	Resources	Actors	N	%N	Descriptive Statistics		Network Power
						P/T	N/P	
Operational Network	Exchange of knowledge and information (4) Adaptation and adjustment to changes (4) Profits increase (1)	None	Previous cooperation (3) Pricing conditions and terms of payments (3)	5	20	M=84 SD=3 CV=4 Max=88 Min=80 Range=8	M=8 SD=1 CV=9 Max=9 Min=7 Range=2	Very strong
Sustainable Network	Management and marketing (4) Cooperation in the supply chain (2) Standardisation and implementation of quality standards (4) Optimisation of supplies and provisions (1) Building of community and relationships (1) Sustainable development (1)	Investments (4) Research and development (4)	Transactional relationships (2) Formal contracts (3)	10	40	M=73 SD=4 CV=5 Max=79 Min=69 Range=10	M=20 SD=5 CV=26 Max=27 Min=8 Range=19	Strong
Social Network	Exclusive cooperation (3) Lobbying (4)	Social relationships, family and friendships (2)	Informal contacts e.g. meetings, trips (3) Social media (3)	5	20	M=51 SD=4 CV=8 Max=57 Min=46 Range=11	M=4 SD=6 CV=11 Max=63 Min=50 Range=13	Moderate
Innovative Network	Improving innovation (1)	None	Trade associations (2) Business to business platforms (B2B) (3)	3	12	M=39 SD=4 CV=11 Max=44 Min=36 Range=8	M=84 SD=17 CV=20 Max=100 Min=67 Range=33	Weak
Shared Resources Network	None	Shared resources e.g. land, labour (2) Common equity or capital group (2)	None	2	8	M=19 SD=9 CV=47 Max=25 Min=13 Range=13	M=238 SD=88 CV=37 Max=300 Min=175 Range=125	Very weak
N	12	5	8	25	100			
%N	48	20	32	100				
Descriptive Statistics P/T	M=71, SD=14, CV=20, Max=86, Min=44,Range=42	M=45, SD=26, CV=57, Max=69, Min=13, Range=57	M=61, SD=20, CV=33, Max=88, Min=36,Range=52					
Descriptive Statistics N/P	M=28, SD=25, CV=88, Max=86, Min=8, Range=77	M=114, SD=122, CV=107, Max=300, Min=22, Range=278	M=41, SD=33, CV=82, Max=100, Min=7,Range=93					

Notes: a) Network dimensions: (1) objectives and functions, (2) regulations, (3) origins (4) outcomes; b) Relative measures: N-number of variables, %N- percentage of number of the total variables, P/T-positive answers to total answers, N/P-negative answers to positive answers, c) Descriptive statistics: M – mean, SD – standard deviation, CV – coefficient of variation, Max – maximum value, Min – minimum value, Range = Max – Min. Source: own elaboration based on data from questionnaire carried out in October 2017.

Only the resources layer could be recognised. This group of very weak attributes can be classified as a shared resources network.

The matrix of categorisation of ION relations in the ARA model has been charted (Table 4). Among 25 observed attributes for network objectives and functions, regulations, origins and outcomes are the primary and stable dimensions that can be distinguished. In the three columns representing the model layers, 25 attributes have been classified and their dimensions have been indicated in brackets. Network activities are characterised by most of the attributes - 12. They comprise around half of the total attributes. Actors attributes are ranked second from the viewpoint of the significance, as assigned by eight attributes, i.e. 32% of total attributes. The least important are resources, we operationalise resources with five attributes (20% of total attributes).

In the activities layer five attributes of objectives and functions dimension and five attributes of outcomes dimension dominate. The least important roles are played by two attributes of origins and regulations dimensions. The actors layer is defined by six attributes, that are fundamental for creating network relationships. The last two attributes represent dimension of regulations. In the least intensive layer of resources there are three attributes for dimension of regulations and two attributes for outcome dimensions.

The results from this analyse show the three layers are not individual compartments, they are mutually interconnected. They have an open nature and can be fulfilled with the operational variables relatively to specific network attributes. These layers are of complex character. This is specified by overlapping some dimensions including objectives and functions, regulations, origins and outcomes in the selected layers. This overlapping is not limited, but some limits are created by logic-cognitive fundamentals for creating scientific constructs. One of these constructs is the network relationships in the context of network approach.

Taking into account the relative measure P/T we can see that the highest mean (71) was found for activities, lower for actors and the lowest for resources. Opposite the distribution measures rank the highest for resources, then actors followed by activities. The N/P measure confirms the distribution in resources and coherence in activities. The mean for resources equals 114, and for activities it equals 28. The dispersion measures (SD, CV and Range) confirm the highest statistical discrepancy for resources.

Therefore, both of the relative measures confirm the highest consistency for the operational relations. The value of the mean for P/T measurement is ranked 84 operational network, 73 sustainable network, 51 social network, 39 innovative network and 19 for shared resources network. The same ranking is found for the variation coefficient (CV). The lowest values are for operational network (4) and the highest for shared resources network (47).

6   Conclusions

This paper introduces a case study based on a direct questionnaire to investigate inter-organisational network relationships in agribusiness The research carried out allowed us to gain insight into and comrehensive knowledge of the complex and highly interdependent objectives of agribusiness networks in the businesses questioned.

The network approach has been applied to the study of agribusiness networks. It was transformed into pragmatic model. Different theoretical approaches - ARA and IOR have been allied with the contemporary context of agribusiness.

It shows that the theoretical ARA model can be applied to agribusiness research. This led to the conclusion that a network is created by the common activities of it's participants. The advantages and disadvantages were operationalised with the relative measures and confirmed with descriptive statistics.

It can be stated that the research confirmed the main hypothesis of this paper; that network relationships have distinguishing and complex attributes that are highly dependent on the network's objectives, and lead to the definition and categorisation of agribusiness networks.

The descriptive statistical measures confirmed the findings based on the relative measures of the significance of the identified categories of IONs in the studied businesses. In turn, the names of IONs come directly out of the principal attributes. They led to the following categorisation of inter-organisational network relationships, connecting the attributes and their significance in the studied businesses:

- very strong operational
- strong sustainable
- moderate social
- weak innovative
- very weak shared resources.

The studied network objectives and functions are increased profit, optimisation of supplies and provisions and building communities and relationships. Networks are regulated by transactional relationships, cooperation in the supply chain, social relationships, and family and friendship. They are originated by the pricing conditions and terms of payments, previous cooperation and formal contracts. The most important outcomes of networking are: exchange of knowledge and information, standardisation and quality standards implementation, adaptation and adjustment to changes.

The study also identified interdependencies between network objectives and the correlation measurement of interdependencies between different objectives of IONs in the businesses questioned. In general it can be concluded that most of the objectives were strongly interconnected with each other. The only medium connection was noted for improving innovation with the other objectives. We can conclude that the businesses questioned combine different objectives in their IONs. It is interesting that sustainable development and increased profits are not recognised by the businesss questioned as conflicting objectives in sustainable networks.

The research shows that the activities and actors layers are well developed, and the resources layer is only well developed in non-material resources including knowledge and information or social relationships. This means that the agribusiness networks do not intend to share material resources including land or capital and labour.

This study draws practical conclusions for the agribusiness sector, it highlights the weakness of resource, innovation and social relationships. This will cause problems in the future due to increasing competition, especially on the export markets, which is driven by rising nutritional requirements and increased consumer demands. The agribusineses networks need to refocus and increase their investment to improve operational relationships, leading to long-lasting, innovative and shared resources relationships which will improve sustainability in the future.

This findings of this study are limited by the sample size, which should not be regarded as the statistically significant and the wider conclusions drawn by this research should not be applied to the wider agribusiness sector. This research should be regarded as a qualitative analysis of a small number of agribuisness networks, that lays the foundations for future work in larger networks and different agribusiness sectors.

Acknowledgement

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