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# CURRENT CHALLENGES OF AGRICULTURAL BUSINESS AGAINST FARMING ECONOMIC EFFICIENCY AND SUSTAINABLE DEVELOPMENT

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The paper investigates circumstances determined modern agriculture and agribusiness challenges and shows methods ensuring sustainability of value-added agriculture and rural areas taking into account, inter alia, climate change, healthy food, organizational and technological progress.
The aim of the article is to show that combining the agribusiness circumstances and methods allows to ensure sustainable development, value-added agriculture and rural areas. To verify adjustment farming processes according set up goals the questionnaire survey on farm equipment and information systems was carried out in 2017 in Kujawy & Pomorze region. The questionnaire was sent to all participants in the supply chain of that particular company.
The challenge facing modern agriculture is the ability to efficiently implement farm innovations, acquire new knowledge and effective use of the farming progress achievements. Negative effects of intensive farming for environment cause to seek for solutions let face economic and environmental challenges for contemporary agriculture and rural areas development. Serious threatens in a climate change can cause imbalance in food supply and demand. Observed higher frequency and severity of adverse weather events require genotypic adaptation. Hence, some studies on genetic progress in those crops adaptation were presented. Also some approaches how to assess and collect data for yield gap analysis, and to summarize the yield gap explaining factors were identified. The presented results showed that although management and edaphic factors are more often considered to explain the yield gap, both farm characteristics and socio-economic factors often explain the yield gap.

*Keywords: agriculture, competitiveness, economic efficiency, farms, food security, sustainable development*

## INTRODUCTION

Currently intensive, industrial agriculture (absorbing high amounts industrial means production) develops as a result of food supply and other raw material kinds growth need (bioenergetics, fibre, pharmaceutics). In other side there is a necessity to held profitable mostly of small area farms through increase of productivity of land, labour and capital (the EU countries, except of the U.S., Australia, New Zealand, some countries of Middle Eastern Europe, Latin America or Asia), (Przegon, 2009). In turn negative effects of intensive farming for environment cause to seek for solutions let face economic and environmental challenges for contemporary agriculture and widely also for rural areas development. Such challenges are considered by politicians responsible for sustainable development let ensure not only welfare and friendly environment for current generation but also for future ones. Hence, European Union's rural development policy overarching objectives like improving the competitiveness of agriculture, achieving sustainable management of natural resources and climate action and balanced territorial development of rural areas.

The purpose of the paper is to indicate merging agribusiness circumstances and methods let ensure sustainability and value-added agriculture and rural areas too.

Particular agendas of the EU administration let define priorities for research & development sector to finance programs and projects giving a chance for finding panacea against negative effects of industrial agriculture domination. So, actions against land degradation (erosion, soil structure damaging, lime leaching etc.) like green zones protection, foresting, organic fertilization and others are undertaken. Serious threatens in a climate change can cause imbalance in food supply and demand what requires crop genotypic adaptation. Many studies have been done to solve and mitigate risk resulted from climate change for food shortages. While some recent of them emphasized the translation of suitability for agricultural crops to the Northern parts of Europe or assessed the climate change impact, other focused on the adaptive measures for agriculture (Marcu, 2013).

Among them one can mention crop cultivar development and improved agronomic practices are pivotal to climate change adaptation for agriculture (Ewert, 2015; Rotter, 2015). One of the most effective adaptation options for future climates is the development of climate resilient crop cultivars (Challinor, 2014). In parallel, agronomists develop new agronomic practices for a changing climate (FAO, 2010). Plant breeders more use genomics and biotechnology to develop cultivars of greater yield stability in our current production systems. It is, however, difficult to develop crop ideotypic traits for a targeted environment. It is also expensive in terms of labour, time, and funding requirements to determine the values of the different traits particularly under future climatic conditions (Gouache, 2016).

Process-based crop models developed for simulating interactions between genotype, environment, and management are widely applied to assess impacts of environmental change on crop development, growth, and yield (Asseng, 2015), as well as to design adaptation strategies to cope with climate risk. In recent decades, crop modelling has become an important tool for evaluating new cultivars (Gouache, 2016) and supporting plant breeding (Rotter, 2015) in particular in the design of ideotypes, i.e. ‘model plants’, for different crops and cultivation environments (Semenov, 2013). Recently, ensemble modelling has been proposed as a valuable approach for assessing and reducing uncertainties in crop simulations.

Climate change and its associated higher frequency and severity of adverse weather events require inter alia genotypic adaptation. Food supply and food security in Europe as well as in many other parts of the world especially depend on the cereals crops, which include wheat, barley, rye, and fodder crops. Barley (*Hordeum vulgare* L.) is a good model for study of the genetics of stress adaptation (Moshelion, 2015) because many quantitative traitloci and candidate genes for biotic and abiotic stress tolerance have been identified. The authors developed a new approach to design future crop ideotypes using an ensemble of eight barley simulation models (i.e. APSIM, CropSyst, HERMES, MCWLA, MONICA, SIMPLACE, SiriusQuality and WOFOST). They applied them to design climate-resilient barley ideotypes for Boreal and Mediterranean climatic zones in Europe (Fulu Taoa, 2017). The findings showed that for both Boreal and Mediterranean climatic zones, barley ideotypes under future climatic conditions should have a longer reproductive growing period, lower leaf senescence rate, larger radiation use efficiency or maximum assimilation rate, and higher drought tolerance. Such characteristics can produce substantial positive impacts on yields under contrasting conditions. Moreover, barley ideotypes should have a low photoperiod and high vernalization sensitivity for the Boreal climatic zone; for the Mediterranean, in contrast, it should have a low photoperiod and low vernalization sensitivity. The drought-tolerance trait is more beneficial for the Mediterranean than for the Boreal climatic zone. Presented study demonstrates a sound approach to design future barley ideotypes based on an ensemble of well-tested, diverse crop models and on integration of knowledge from multiple disciplines. Other published findings on barley let prove that too high a temperature, particularly in the final stages of the growing rape, reduces the yield of the plant. These results can be used in shaping the genetic progress in mitigating the effects of rising temperatures on the yield of this economically important plant as it is rape. From those research it has been also proven statistically that analysis of dependencies type of crop – weather can be reduced, based on the previously discussed empirical studies in Pomorze & Kujawy region, from six plants into four groups, which provides valuable information methodically important for the continuation of research on dependencies between agricultural productivity of the region and climate changes and predicting their effects in the future (Bojar, 2013).

## SUSTAINABLE PRODUCTION: ADAPTIVE ON-FARM RESEARCH IN FARMERS’ FIELDS

Another approach to solve important problem of economic and environmental goals amalgamation is a yield gap analysis. It is gaining increased scientific attention, as estimating and explaining yield gaps shows the potential for sustainable intensification of agricultural systems. Explaining yield gaps requires detailed information about the biophysical environment, crop management as well as farm(er) characteristics and socio-economic conditions in which farmers operate. However, these types of data are not always available, mostly because they are costly to collect. The main objective of this research is to assess data availability and data collection approaches for yield gap analysis, and to summarize the yield gap explaining factors identified by previous studies. For this purpose, a review of yield gap studies (50 agronomic-based peer-reviewed articles) was performed to identify the most commonly considered and explaining factors of the yield gap. Besides a global comparison, differences between regions, crops and methods were analysed as well. The results show that management and edaphic factors are more often considered to explain the yield gap compared to farm(er) characteristics and socio-economic factors. However, when considered, both farm(er) characteristics and socio-economic factors often explain the yield gap. Especially it is noticed a need to integrate different biophysical and socio-economic models hat is necessary to find out pragmatic solutions (Bojar, 2015). In other side qualitative methods based on expert knowledge can include the largest range of factors. Although the data included in yield gap analysis also depends on the objective, knowledge of explaining factors, and methods applied, data availability is a major limiting factor. Bottom-up data collection approaches (e.g. crowdsourcing) involving agricultural communities can provide alternatives to overcome this limitation and improve yield gap analysis.

## METHODS OF COMBINING SUSTAINABLE AGRICULTURE WITH ITS ECONOMIC EFFICIENCY

The principle of sustainable development is a fundamental assumption of Ecological National Politics. It assumes the balance necessity between economic targets as well as social and environmental ones. In order to create the full-balanced life model the activity integration in three crucial areas is necessary: achievement of long-term economic growth, nature resources and environment protection as well as social development which assures the realization of basic public needs. An important role in creating sustainable development is attributed to small and medium-sized enterprises, characterized by flexibility, creativity and adaptability to changes in local, national and world markets. It is considered necessary to remove legal and institutional barriers that hamper the functioning of small and medium-sized enterprises, stimulating their creativity and facilitating access to technology.

The most important purpose of ecological politics is to reduce resource consumption of productive process, because this is the only way to realize the principle of liquidation the pollution, burdensome and dangers at their source. Decreasing of resource consumption allows additionally to achieve economic benefits in the form of decreasing inputs on production, and as a consequence the decreasing the burdens which come from exploiting nature resources. The strategy for production balancing as the result of decreasing resources utilization embraces the creation of system for control the resource consumption by introducing indicators for water-, material-, and energy consumption as well as for wastes generation into public reporting and statistics system, into national environment monitoring, into the local and regional sustainable development and environment protection systems and into sector strategies (Hadryjanska, 2008).

The close link between agriculture and the whole economy reflects the relative weakening of the importance of the agricultural sector along with the development of non-agricultural sectors. This process implies improving the efficiency of farming management by intensifying the rivalry of food producers under relatively stable demand. The presented changes in agriculture, together with the economic growth, illustrate the transformation of peasant farming towards farmer and then towards agribusiness enterprises (Tomczak, 2004).

In particular, the costs associated with the negative impact of intensive agriculture on the environment and the rural community in European agriculture indicate the need to verify the efficiency of industrial agriculture. At the same time, consumers increasingly pay attention to the quality and origin of food products (Kwasek, 2011). The result is increased interest in regional and ecological products to the disadvantage of mass-produced products. The presented processes have forced the search for alternative models of agricultural development meeting the criteria of sustainable development, which is equated with Sustainable Agriculture and Rural Development (SARD). In particular, the SARD concept points to the contradiction between the dynamic economic growth of agriculture and its sustainability in the long run. Considering the research of Kobialka et al. (2015) substitution of labour for capital was beneficial in different types of farms, as it reflected the implementation of the strategy of minimising the own production costs along with the maximisation of the production scale. However, the analysis of the substitution of labour for capital in the surveyed commercial farms oriented towards crop production revealed less favourable results.

Globalization processes force the economic efficiency of market-based farming to rise, and the growing globalization and competition raises the question of the economic sustainability of European and Polish agriculture. (Zegar, 2011). “EUROPE 2020 – A strategy for smart, sustainable and inclusive growth” points to the introduction of energy-saving and material-efficient technologies into the European economy as one of the drivers of economic growth. As regards agriculture, the need to increase agricultural production has been highlighted by the interference of new technologies and the implementation of technical and biological progress. As in European strategy, the development of the Polish economy is considered from a perspective of its sustainability. Regarding the agricultural sector, the need to adopt agricultural policy and rural development solutions that guarantee food security is emphasized. Strengthening Poland's food security should be achieved by modernizing the agricultural sector leading to increased production capacity, preserving agricultural production potential and promoting the production and consumption of high quality food. Such directions of development directly refer to the balance of the economy in the economic and social sphere and indirectly ecological (Florianczyk, 2012). Findings of Jazepcikas (2011) research show that the differences of the trajectories of the economic development across the agrarian regions are substantial thus special methodologies for an assessment of the sustainable development in agrarian regions are required. Research also shows, that the remoteness of the agrarian region from the industrial (i.e. urban) regions increases amplitude range of the sustainable development thus better profit margins are required from the investments in remote agrarian regions than anywhere else.

Among companies, which take up ecological challenges, different activity strategies may appear depending on the way of treatment environmental purposes: as danger or as market chance. A passive approach concentrates only on obedience the regulations in order to protect the company against excessive costs. A defence approach focuses on withdrawal products from the market and partly resignation from the most environmental burdening technology and improvement the utilized technologies and manufactured products. An innovative approach consists in adopting new technological and productive solutions, which favour nature environment. An offensive strategy consists in applying modern environment management systems according to norm ISO 14 001 standard or EMAS (Luczka-Bakula, 2005).

The challenge in modern agriculture is the ability to efficiently implement farm innovations and acquire new knowledge (Prus, 2017) and to make effective use of the achievements of biological progress in plant production. Globalization processes are a catalyst for the transfer of innovation and the spread of technical, biological and organizational progress. The ability to use innovation in Polish agriculture will determine its development chances and competitive position at the international level (Zak 2017).

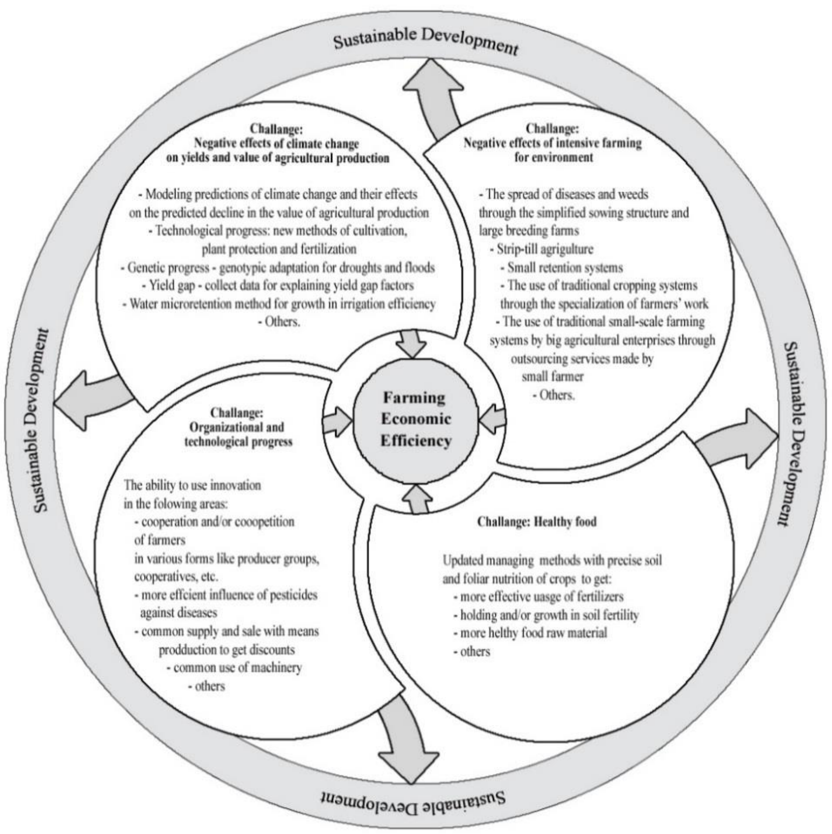
Strip-till can be used to counter drought, but is also one of the simplified cropping systems used increasingly by farmers looking for savings. The method involves loosening a narrow lane of soil with simultaneous sowing of seeds and bringing mineral fertilizers, often also organic ones, and the necessary amount of plant protection products. Sowing takes place in a loosened soil belt, which is covered with mulch. Mulch is formed from the organic matter left in the field (straw or intercrops). Commonly mentioned advantages of belt application include: protection of soil by erosion, non-interference in soil structure, reduction of energy and work inputs, and perhaps the most important feature nowadays is the reduction of water loss during the growing period.

Reduction of the cost of mechanization may, however, appear unreasonable because simultaneous rinsing, seed sowing, mineral and organic fertilizers and plant protection products require costly specialized machines. In the case of separation during the growing and sowing process, inputs are required for a global positioning system with a GPS-RTK correction signal with a plus / minus of 2.5 cm. In addition, the application of the method requires particular attention in designing the crop rotation sequence and consequently also affects yield and weed infiltration (Przybył, 2014).

Irrespective of other constraints associated with lattice cultivation, such as the need for mulching of crop residues or hindering of sowing, it becomes increasingly difficult to implement agro-technical treatments to reduce the cost of labour and energy. Restrictions on workflow resulting from the planting of the strip-till crop have an ever-increasing economic dimension on large areas of crops. The process of carrying out cultivation is directly related to fuel expenditure. According to preliminary observations, belt crop allows on average a minimum of 50% of fuel economy.

Documented water shortages during the rises in many parts of the country force the protection of their resources in the soil, hence more frequent cases of using mechanization services in this area. The use of such a solution is supported by the possibility of reducing water losses from soil by completely abandoning the cultivation work. Newly available tillage services may include the following operations performed during one drive: pruning, cut the soil to a depth of 10 cm, optional extra spread for double corn, soak and aerate the soil to a depth of 35 cm, application of fertilizer, closing the gap, compacting and levelling the soil, planting the plant, levelling of the soil surface. The use of innovative agricultural treatments, which are environmentally friendly or counteract the consequences of current climate change, is one way to improve yield quality and production profitability (by using the Decision Support System – DSS for precise soil and foliar nutrition of plants during the growing season, the water microretention method for irrigation as well as economical irrigation systems). Zak also emphasizes (2017) that precision agriculture may be an alternative to traditional agriculture, as it helps facilitate work by using computer assistance which uses data on the spatial diversification of crops within a field.

To verify adjustment farming processes according set up goals – economic efficiency and sustainable development, the questionnaire survey on farm equipment and information systems was carried out in 2017 in Kujawy & Pomorze region. Gathered opinions came from farms of different areas between 5 up to 100 Ha which have long term contracting agreements with local cooler for delivering vegetables. The questionnaire was sent to all participants in the supply chain of that particular company (80 farmers). 39 appropriately answers were received. Around 50 per cent of respondents (nineteen in thirty-nine) own modern machinery and 17 ones use Internet as a source of business information. A part of them looking for information on agricultural exchanges, stock exchanges and banks. Hence, presented opinions confirms thesis that farmers take attention pointed within fig. 1 challenges to be successful.




*Source: own study*

Figure 1. Challenges of agricultural business and proposals of solutions.

Alternatively to use of means of production of industrial origin, sustainable agriculture is the preferred agro-technical treatment that promotes the natural productivity of agricultural land. One of the main indicators for assessing the degree of sustainability of agricultural production is the use of crop rotation to ensure a stable agricultural soil fertility

(Krasowicz, 2005). Proper crop rotation is included in the canons of plant production organizations that reduce the risks to the natural environment, and the observed simplification in the sowing structure requires intervention, e.g. in the form of appropriate instruments in agri-environmental programs (Majewski, 2010). Simplification in agriculture has many advantages such as preventing soil erosion, intensifying biological life in the soil, higher organic matter content and soil moisture, lower fuel consumption, lower $CO_2$ emissions and air pollution. In addition, they reduce energy expenditure, save working time and make fertilizers and pesticides retained in topsoil (Malecka, 2006).

After comparing the economic performance of farms using Norfolian crop rotation with other farms for 2006-2011 (Florianczyk, 2013), it turned out that at the end of the surveyed period, Norfolian farm income was 18% lower than others, while in 2006 they were lower only by 8%. During the considered period, the level of intermediate consumption on Norfolian crop rotation farms, which was key to environmental sustainability, was significantly lower than for other farms. This regularity reflects the relatively lower level of intensity of production of sustainable farms, indicating that the market mechanism prefers conventional farming. Simplification in plant production is conducive to better economic performance, negatively affecting the sustainability of agriculture in the environmental sphere. The slower growth rate of land productivity in Norfolian crop rotation farms indicates the need to look for new, more efficient production technologies specific to them. The link between direct support and sustainable use of agricultural land seems stronger.

The emergence of a social sphere of sustainable agriculture corresponds to the specifics of high labour resources in Polish agriculture and the issue of agrarian fragmentation. Controversies related to the direction of development of Polish agriculture relate, on the one hand, to the need for its moderate intensification and, on the other, to prevent its industrialization stimulated by the market mechanism (Florianczyk, 2013). Best Available Technology was applied to minimize not desired effects for local societies and natural environment. BAT included such elements like permitted level of main ingredients within feed, a reduction of emitting area of slurry, applying efficient system of slurry removing, holding appropriate microclimate in animal buildings, ensuring pigs optimal amounts of specific amino acids, introducing standardized feeding systems including intake equipment, storing devices, preparation devices, transportation equipment and dozing subsystems, applying standardized types of slurry tanks.

## THREATS TO SMALL FARMS

A serious threat is the destruction of small farms with a low degree of mechanization of production processes and specialization of production as a result of the competitive advantage of large agricultural enterprises as well as the asymmetry of the food supply chain, which predominates in the commodity-processing sector (Bojar, 2008, 2014). One of the solutions identified may be creating groups of producers and other forms of farmer cooperation: joint procurement, sales, machinery use, advice, marketing and farmers' support for public funds under EU projects.

The Food and Agriculture Organization of the United Nations (FAO), estimates that increases in food prices may be permanent. This information gives us tips on the future of food, that is, macro-based agricultural production. The fact that the demand for agricultural production increases on a global basis is actually a critical point. Global population growth, the need for developing countries with many populations, such as China and India, destabilizes the supply demand imbalance in agricultural production. Prices are rising when supply is low and agricultural production is appreciating when prices are rising. That is why food and agricultural production are among the sectors of the future. Experts think that there will be names from this area among the wealthy of the future.

Among many branches of agriculture in Ukraine milk-production is emphasized which has direct influence on rural development (work places creation, maintenance of the population with quality food stuffs, ecological agriculture conducting). Milk – production makes 35.2% of gross product cost of animal husbandry and 14.8% of all agricultural production in Ukraine (Slavkova, 2008). One of the factors which influence Ukrainian milk competitiveness positively is its price (30 cents/l) which is much less than in EU countries. Milk production profitability can also be attributed to economic parameters of competitiveness. Comparing quality standards of EU and Ukraine it is possible to say that 69% of milk doesn't correspond with the norms of most European countries in contradistinction to Poland where 5% of such milk is produced and Lithuania (7,6%). Having analysed the basic factors of milk-product competitiveness Slavkova (2008) proposed several means of its increase which will influence the sustainable rural development positively, e.g:

- elaboration of the state support mechanisms of milk-production development,
- elaboration of the breeding animal husbandry support program,
- development of animal feeding innovation technologies to reduce prices fluctuations during a year,
- elaboration of normative documents for milk quality system according to the standards of WTO and EU,
- elaboration of support programs for large manufacturers, individual country farms and cooperative movement.

## CONCLUSIONS

The aim of the article was to show that combining the agribusiness circumstances and methods allows to ensure sustainable development, value-added agriculture and rural areas. The article shows, on the example, that environmental and economic objectives can be combined. Indicated factors of biological, technological and organizational progress as well as progress in the field of building models allow better adaptation of modern agriculture to challenges such as climatic and demographic ones due to the increase in food demand.

The level of productivity of European agriculture in food production, demonstrating its effectiveness, is determined by the process of globalization. The effects of the implementation of modern technology must therefore keep pace with changes in the productivity of world agriculture, not necessarily respecting the principle of sustainable production in the ecological and social spheres. The superiority of assessing the efficiency of European and Polish agriculture in the economic sphere is unjustified in light of this. The boundary conditions for European farms and the absence of such for other market participants are discriminatory in advance. This is due to the investment nature of the modernization processes and the initial decline in productivity appropriate for this process. Investment effects in the form of productivity growth appear with the maturity of the investment. The starting point in assessing the agility of agriculture should be the definition of the target status, i.e. the form of sustainable agriculture in the ecological and social spheres. Evaluation of efficiency in the economic sphere should refer to the direction and pace of changes in this respect. The policy of supporting the development of agriculture and rural areas should be based on the multiple assessment of the efficiency of agriculture, taking into account the need for its support in the economic sphere (Florianczyk, 2012).

Sustainable intensification of agriculture (SIA) is largely on how to enhance agricultural productivity while reducing its environmental impacts. The task is how to produce more food with fewer resources. Sustainable intensification, in this context, seeks to increase agricultural output while keeping the ecological footprint as small as possible. This is a useful and relatively important feature of sustainable agriculture, particularly as mainstream agriculture development still concentrates on productivity and places limited focus on sustainability. One of the most important tasks is the need to develop indicators and measures for the sustainable and economically viable development of agriculture and rural areas (Struik, 2014). Sustainable development of Polish agriculture should consist in achieving efficiency and economic competitiveness with simultaneous ability to achieve sustainability in the social sphere. Achieving these goals is reflected in the modernization of the agricultural sector through the increased use of innovative technologies that are designed to increase agricultural productivity and at the same time to increase the sustainability of organic farming. On the other hand, vertical and horizontal integration of farmers with other actors of food supply chain and sustainable economy is also necessary to face contemporary challenges. Implementing the principles of sustainability assures companies compliance with environmental policy guidelines and also makes the company perceived by consumers as environmentally friendly.

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