

# Development and implementation of an innovative business model to enhance the efficiency of wheat cultivation processes in peasant farms

Zoya Gelmanova\*, and Alibek Batyrbek

Faculty of Energy, Transport and Control Systems, Karaganda industrial university, Temirtau, Kazakhstan

**Abstract.** The article evaluates the efficiency of business processes of wheat growing, allowing to identify the potential for development of the farm. The article examines the variables that form the business model "as it should be". Due to the high level of detail, the business process requires extensive problem solving, considering multiple factors at each stage. The business model is a "guide" to help understand how to proceed. The planned results of updating the business process of wheat growing in the farm will allow achieving a higher level of comparative efficiency of its economic activity as a whole.

## 1 Introduction

The Concept for the development of agro-industrial complex for 2021-2030 and the National Project for the development of agro-industrial complex of Russia for 2021-2025, defined the main tasks: increasing labor productivity in agriculture by 2.5 times, achieving self-sufficiency of the country in the main food products of domestic production, increasing exports of agro-industrial complex products by 2 times with bringing the share of processed products to 70%, stable increase in incomes of 1 million rural residents through the formation of 7 large ecosystems and the implementation of investment projects. The state to solve these problems should take a set of measures that will help to understand how to work further [1,2].

The application of business modeling methodology allows an organization to obtain a number of significant advantages in the issues of improving its business. The purpose of business modeling is to provide a holistic actual picture of the organization's life activity, to ensure mutual understanding at all levels of the organization, to overcome the gap between the strategic vision of business and practical implementation [3-6].

---

\* Corresponding author: [zoyakgiu@mail.ru](mailto:zoyakgiu@mail.ru)

## 2 Research methodology

Business modeling tools allow us to build graphical models, diagrams that demonstrate level by level, step by step, how business processes are built in the company and what needs to be changed to optimize the architecture of the organization. Modern business modeling tools are business design and analysis tools, not IT technologies designed to provide information support for successful business operation.

## 3 Results and discussion

Building a business model of the organization "as it should be" on the basis of a consistent, step-by-step description of business processes and organizational flows (material, labor, technical) allows to identify cross-functional (in all departments of the organization) problems of doing business, and to determine in detail how and to what extent these problems are reflected at each stage of the business process.

This approach to the assessment and analysis of the business process makes it possible to identify and describe the bottlenecks of the existing business architecture, and on this basis to propose a set of measures to improve the business, design and build it according to the principle of "as it should be". The use of business modeling tools makes it possible to calculate the expected consequences of implementing a new model by its components - material, technical, labor, economic and other flows, i.e. to obtain a comparative assessment of performance and efficiency.

Element-by-element assessment of the effectiveness and efficiency of the new business model acts as a tool for planning the organization's activities for the short and medium term, as well as a means of controlling the practical implementation of the main and component tasks. Absence or incomplete compliance of practical results of implementation of the business model "as it should be" with the predicted parameters should be the basis for the development of a new business model or adjustment of the already proposed one taking into account the real requirements.

Description and analysis of the business process model "as it is" of wheat growing in a peasant farm located in Karkarala district allowed us to identify the main shortcomings of the existing business process:

- Violation of rules of agrotechnologies corresponding to natural and climatic conditions of the farm area, i.e. agrotechnologies in conditions of risky farming with arid climate and lack of artificial irrigation of fields,
- Presence of morally and physically worn out machinery and equipment, which do not allow to perform works within agrotechnical terms, are highly costly and low-productive,
- Lack of interest in maximizing the profitability of their business through the fullest involvement of available resources (e.g., land and technical).

In order to quantitatively increase the main indicators of the existing business, we propose to expand sowing areas and use all land plots of the peasant farm in crop rotation.

All land plots of the farm require a significant renewal of the machinery and technical park of the main agricultural machines - tractor, combine, seeders, cultivator and sprayer. As a seed material we propose to use elite seeds of spring soft wheat variety - "Saratovskaya-42", recommended by JSC "KazAgroMarketing" [7].

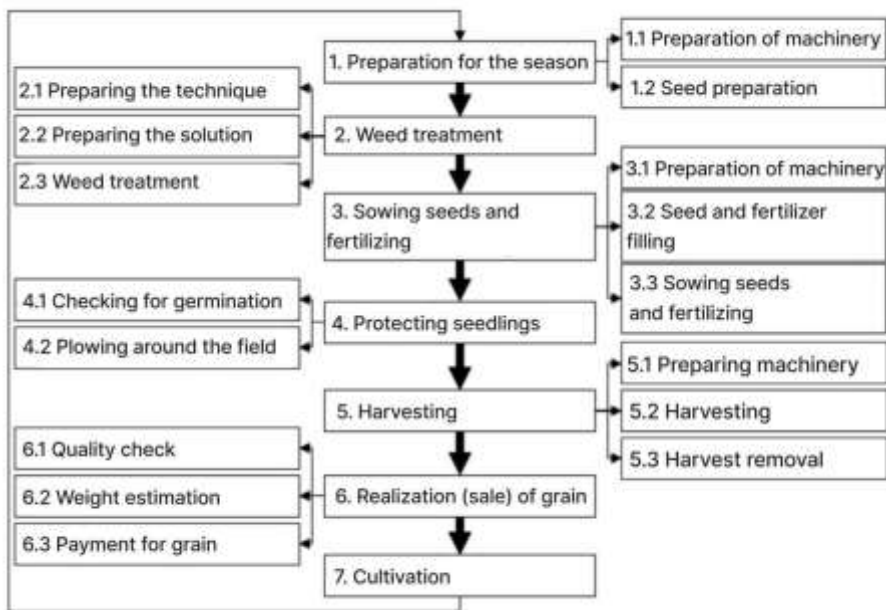
This variety was bred by scientists of the Research Institute of Agriculture "Southeast", variety - albidum. It forms stable yields in all zones of zoning, is included in the list of strong wheat.

The grain is medium-sized and large, the weight of 1000 grains is 30-35 g, the crude protein content in the grain is 14.0-16.5%, glassiness is 71-88%. The variety is resistant to shattering, is medium-early maturing, matures in 68-82 days depending on the conditions and

zones of cultivation, drought tolerant. It is strongly affected by dust bunt and brown rust, and moderately by Swedish fly. Baking qualities are good and excellent, flour strength is high. The norm of wheat seed consumption at sowing is maintained - 120 kg/ha.

The enlarged business process of wheat growing in the farm retains the elements related to input and output. We propose to revise the stages of the main process of wheat growing in accordance with the requirements of zero agro-technology.

Block diagram of the wheat growing process "as it should be" in a peasant farm (Figure 1).



**Fig. 1.** Block diagram of the business process of growing wheat "as it should be".

Let's consider the main stages of wheat growing process "as it should be" in the farm.

The first stage (preparation for the new sowing season) is the same, but it is carried out in new terms - from April 1 to April 30 of each year. The stage includes preparation of all agricultural equipment for field work and selection of seed material for sowing.

The first operation involves checking the condition of the entire machinery fleet. The second operation involves the purchase of elite seeds of spring wheat variety "Saratovskaya-42" in a specialized seed farm. In subsequent years, selection from the previous year's crop is possible.

At the second stage we propose not to carry out any tillage in order to preserve water and mineral-salt accumulation of soils. Instead of plowing or cultivation to carry out herbicide treatments of fields to control weeds. It is necessary to perform three types of operations - preparation of machinery, preparation of solution and herbicide treatment of fields from weeds. These works should be carried out during the period of active growth of weeds - for Karkaraly district - from May 1 to 10 of each year, and the total duration of works - 8-10 days depending on weather conditions.

The first operation is the preparation of equipment, adjustment and setting up of the sprayer. Before the start of works, the equipment is adjusted and set up, i.e. the boom height and the rate of liquid flow through the atomizers are set.

The second operation - preparation of herbicide solution, obtained by mixing water with liquid herbicide. The operation is repeated many times as the fields are sprayed.

On the territory of agricultural land plots mainly grow annual and perennial cereal and dicotyledonous weeds. According to the recommendations of experts of KazAgroMarketing JSC [7] and representatives of the Department of Agriculture in Karaganda region for their treatment it is necessary to use herbicides of continuous action.

According to the recommendations of experts of KazAgroMarketing JSC [7,9] and agronomists Karkarala district the most effective means of combating the existing types of weeds is a continuous action herbicide "Uragan Forte 500, V.R." Syngenta Kazakhstan, LLC, which we propose to use for the updated business process.

The third operation within the second stage is the treatment of weeds by spraying the fields with herbicide solution. According to the recommendations of agronomists the best time for effective (efficient) herbicide application is the morning - from 4 to 9 hours.

The third stage is sowing seeds of the new crop. From May 15 to 25 of each year three operations are performed - preparation of machinery, seed filling and fertilizing, sowing of grain and fertilizing, with the total duration of work - 7-10 days. All operations are carried out in the field.

The first operation - preparation of machinery - involves adjustment of seed rate, fertilizer application and planting depth of the grain drill. The second operation - filling of seeds and fertilizers in seeders is carried out manually, from the approaching car grain and fertilizers from bags (capacity of 50kg) is poured into seeders. For meadow-chestnut soils of Karkarala district, ammonium nitrate used for pre-sowing application is considered to be the best fertilizer for wheat cultivation. Ammonium nitrate grade "B" (NH<sub>4</sub>NO<sub>3</sub> - GOST 2-85) contains not less than 34.4% of nitrogen and is produced with the use of conditioning additives containing calcium, magnesium, sulfate with phosphate.

The third operation is sowing of seeds and application of mineral fertilizers into the soil. Seed sowing is carried out in a row method with a distance between rows of 15 cm consecutively from one land plot to another, the movement of the seeding unit on the field occurs in a straight spiral parallel to the length of the field.

The next - fourth stage, seedling protection measures, remains unchanged. The same operations are carried out in this stage - seed germination tests and plowing around the field.

The first operation - seed germination test - is carried out ten days after the completion of all sowing activities, within one working day - usually on June 5 of each year - and includes visual inspection of all land plots of the farm. The seed germination rate for this period is the same (5-7cm).

The second operation - plowing around the field for fire protection is carried out from June 25 to July 5 of each year. Field plowing is carried out at a distance of 20m from the edge of land plots in a continuous strip along their entire perimeter. To perform plowing works around the field, the MTZ-1221 wheeled tractor with a four-corner plow with a 1.4m grip is used. Processing speed is 12km/h, processing time - 1-2 days (depending on weather conditions) from 8 to 23 hours of daylight hours. No other field work is carried out before harvesting. Rainfall carry out irrigation of land plots.

The fifth stage is harvesting, preparation of machinery, harvesting of crops and their transportation to the consumer. The total duration of works is from 7 to 25 days depending on weather conditions. It is carried out in the period from September 5 to September 30 of each year.

The first operation is preparation of the combine for harvesting and adjustment of the cutterbar mowing level, which is carried out directly on the field before the start of work.

The second operation is harvesting with the help of the Yenisei-1200-1HM combine harvester with the ZhKN-7Sh cutterbar. This combine harvester is designed for harvesting fields with low or medium grain yields, including wheat. In the combine's hopper (capacity of 4500 liters) at one time can be threshed up to 3.3-3.6 tons of grain depending on its moisture content.

The third operation is transportation of the harvested grain to the elevator. Costs and one-time volumes of harvesting are the same.

The fifth stage includes the following works:

- Harvesting with the grain harvester "Yenisei-1200-1NM" (chopper) with the reaper ZhKN-7Sh, which has a working width of 7 m. The speed of the grain harvester is 8 km/h, processing time - 5-20 days (depending on weather conditions and the speed of harvest removal from the field) from 8 to 23h of the day,

- Harvest removal by a KamAZ-5320 truck with a GKB-8350 trailer with a total capacity of 16 tons. The time of harvest removal will increase due to the increase in yield and will amount to 22-25 days. Morally and physically worn out machinery and technical means do not allow to carry out works within the established agrotechnical terms, and also they are high-cost and low-productive.

The sixth stage of the business process remains the same. This is the sale of the harvested crop - quality inspection, weighing and payment for the delivered grain. The sale of the harvest is carried out in the same time period. The sixth stage is repeated many times during the entire harvest period, but more times (16-17). At the same time, all three operations are performed, which have the same duration (3-4h). The total duration of all operations will be 68h or 17 days.

The first operation - grain quality check, during which the quality of the delivered grain is assessed. The second operation - weighing remains unchanged and includes the same types of work - weighing and unloading of the machine with the same duration of operations. Weighing takes place on trestle scales in two stages: determination of gross weight, then calculation of net weight. The unloading operation is carried out in the same order of operations and the same terms. After evaluation of the quality and weight of the grain, payment for the delivered grain takes place. This operation is carried out under the same conditions and in the same form.

The last, seventh stage of the business process "as it should be" involves cultivation works - from October 1 to October 10 of each year, with a total duration of 4-7 days. This stage of works is preparation of soils for the next sowing season. It is loosening of compacted top layers of soil, cutting of roots and residues of wheat sprouts, which form crop residues and spread on the surface, covering the field with shredded wheat ear and weeds. Under this cover, moisture is well retained and it is much more difficult for weeds to germinate. The crop residues are left on the field until spring and do not interfere with direct sowing. Thanks to them there is effective snow retention and moisture conservation. The principle of operation of the natural mechanism: when water freezes, it expands and breaks the bonds between soil particles, i.e. a giant natural plow works, which does not require any expenses. This makes it possible to avoid plowing the field before the start of a new season of field work.

After the seventh stage (October 10), the annual cycle of agricultural works (i.e. business process of wheat growing "as it should be") is completed.

In the following years it is expected to reduce works related to cultivation of fields and their herbicide treatment (as weeds decrease on the fields), which makes it possible to gradually switch to the zero tillage system.

The applied wheat growing technology will increase the average annual yield from the land plots involved in the crop rotation, including through the use of new and better seeds, moisture-saving technologies and mineral fertilizers.

In the business - process "as it should be" of wheat growing in agriculture there is a single variant of fulfillment of all works, which has the following characteristics:

- Increasing the number of stages of the business process from six to seven, which will allow full compliance with agro-technologies in the area,

- The period of all agricultural work in one year is from April 1 to October 10 of each year, for a full 193 days or 68 days of net working time.

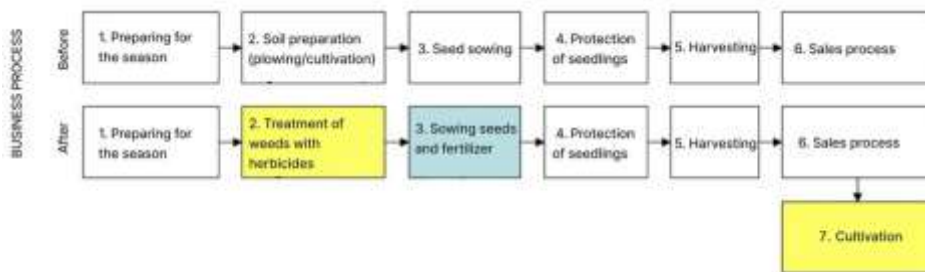
## 4 Conclusion

The proposed business process "as it should be" for wheat cultivation in agriculture allows us to draw the following conclusions:

We propose to carry out all agricultural works taking into account natural and climatic conditions of the farming area and gradual transition to zero tillage technology,

- In order to maximize the profitability of farming it is necessary to fully utilize all areas of the farm in agricultural turnover with the possibility of expanding the sown areas,
- The applied agro-technologies will help to preserve water and mineral-salt accumulation of soils (no deep tillage of soils in the pre-season period is planned). During the annual crop rotation we assume the use of zoned mineral fertilizers (ammonium nitrate with additional components), which will increase soil productivity. To increase yields it is possible to use new seeds - elite varieties of spring wheat "Saratovskaya-42". In this case we expect an increase in yield of all land plots of the farm.

The planned results of updating the business process of wheat growing in the farm will allow achieving a higher level of comparative efficiency of its economic activity. To confirm this, a comparative assessment of the farm's performance under both business processes is required. Figure 2 [8,10] shows a general visualization of changes in the main stages of the business process of wheat growing in the farm.



**Fig. 2.** The main steps in the business process of wheat farming in agriculture before and after improvements.

In Figure 2 we can note the following qualitative-quantitative improvements in the main stages of the business process:

- At the second stage: instead of deep tillage of soils by plowing or cultivation in the "before" process, herbicide treatment of fields in the "after" process should be applied - this will allow preserving naturally accumulated moisture and mineral-salt deposits of soils, which will increase yields,
- At the third stage: when sowing seeds in the "after" process, mineral fertilizers (ammonium nitrate with the use of conditioning additives) should be simultaneously applied, which was not done in the "before" process - this will make it possible to replenish the decreasing mineral-salt balance of the farm's soils,
- A new stage is introduced - the seventh stage - cultivation of fields after harvesting, which completes the annual crop rotation and is a preparatory work for the next sowing season. Cultivation of fields will allow to remove the remains of wheat growth and weeds, loosen the compacted topsoil, accumulate and preserve natural moisture in the soil during the non-sowing season (fall-winter-spring). Cultivation of fields in the fall allows the farm to start a

new sowing season (stage two) without deep tillage. Its efficiency is manifested at the second stage.

## References

1. National project on development of agro-industrial complex of the Republic of Kazakhstan for 2021-2025, <https://primeminister.kz/ru/nationalprojects/nacionalnyy-proekt-po-razvitiyu-agropromyshlennogo-kompleksa-respubliki-kazahstan-na-2021-2025-gody-1594449>
2. On approval of the Concept of development of agro-industrial complex of the Republic of Kazakhstan for 2021 - 2030 years Resolution of the Government of the Republic of Kazakhstan from December 30, 2021 № 960, <https://adilet.zan.kz/rus/docs/P2100000960/links>
3. M. Morris, M. Schindehutte, J. Richardson, J. Allen, J. Small Bus. Strategy **17**, 27 (2006)
4. M. Morris, M. Schindehutte, J. Richardson, J. Allen, J. Bus Res. **58**, 726 (2005)
5. C. Zott, R. Amit, L. Massa, J. Manag. **37**, 1019 (2011)
6. B. W. Wirtz, A. Pistoia, S. Ullrich, V. Göttel, Long Range Plan **49**, 36 (2016)
7. List of organizations, price and technical characteristics of continuous herbicides, KazAgroMarketing JSC, <http://www.kazagro.kz>
8. Z. S. Gelmanova, A. G. Butrin, Int. J. of Applied and Basic Research **1-2**, 210 (2016)
9. N. Bocken, Y. Snihur, Long Range Plan **53**, 1019 (2020)
10. S. Pfeifer; S. Oberman, S. Peterka, M. Stanic', Manag. J. Contemp. Manag. Issues **22**, 1 (2017)