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WORLD EXPERIENCE OF AGRICULTURAL START-UP DEVELOPMENT: LESSONS FOR UKRAINE

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Abstract. *The article defines the specifics and principles of creating startups which are based on an innovative idea, and highlights the world experience of innovative agrarian start-ups functioning. The first agrarian start-ups were created in Israel almost 30 years ago, where the start-up industry is successfully developing now, examples of the most successful of them are given in the article. Sources of financing of agricultural start-ups in foreign countries are identified, the main of which are venture funds, business angels, etc. The experience of innovative agrarian start-ups functioning in Ukraine is highlighted.*

Keywords: *Agrarian sector of economy, Innovative agrarian start-up, Venture funds, Business angels, All-Ukrainian Agrarian Innovations Hackathon.*

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The agrarian sector is a strategically important branch of the economy on which food security and the independence of our state are based. The agricultural sector provides jobs to the overwhelming majority of the rural population of Ukraine, as resources are reduced and the population of the planet grows, the development of new solutions for agriculture becomes especially urgent.

Competitive functioning of agricultural enterprises is impossible without the implementation of innovations. It becomes the most effective when orienting mainly on regional needs for innovations, which are defined by taking into account the natural and climatic conditions, the production structure and the state policy on innovations.

Nowadays it is an urgent need to form a system for communicating information about innovations to improve economic development and environmental safety of agriculture by developing information systems to provide management and improve the efficiency of existing production systems, to potentially affordable enterprises.

The development of an innovative economy involves cooperation between entities having innovative products and those who want to implement them. At the same time, the formation and development of start-ups is one of the promising forms of such cooperation. The startup is seen as entering the market with an innovative project of a new company in a short time and with minimum investment. In other words, start-ups are innovative, limited by initial investment, rapid in development (they are created on average for 3-4 months), not always having high chances for success. A peculiarity of start-ups is that they are created for the production of goods or services in a highly uncertain environment in order to profit in the future. Start-up should be based on a certain innovative idea of something that either does not exist at all or is in limited quantities.

For a start-up to function successfully it is necessary to assess the prospects for the development of the market where the product is to be sold, the customers, competitors, strategy and tactics and finance of the company. The basic principles when creating startups are: the product must be produced quickly, efficiently and with the minimum cost. Financing the start-ups at the initial stage is done by its founders. These funds are allocated to cover the first costs - the development of a business plan, a prototype of the future product, etc. Further investment is made by the investors interested in the development of start-ups.

Startups are quite widely created and successfully developed in foreign countries. A large start-up industry is being developed successfully in Israel now, where the first start-ups were created almost 30 years ago. Today, Israel is confidently leading the world by the number of start-ups per capita, the country has even established the "Startup Nation" brand. The Israeli start-up industry is being developed rapidly - according to Startup Genome research, Tel Aviv ranks the second in the

world after the Silicon Valley and in the rating of the most innovative countries from Bloomberg, Israel entered the top five, even ahead of the USA and the UK.

A significant number of Israeli start-ups emerged due to the lack of resources. In this country hundreds of venture funds and business angels (people who invest money from selling their business into start-ups) are now looking for attractive innovative projects to finance them. In Israel 5000 start-ups account for 250 venture funds (about 70 of them are local), over 1000 business angels and an impressive number of incubators (a separate type of investor, an organization that supports, promotes and finances innovative projects), accelerators (organisation which helps other companies), state and interstate programmes to support start-up companies.

Venture fund is an investment company, working exclusively with innovative enterprises and projects (start-ups). Venture funds invest in enterprises with high or relatively high risk in anticipation of extremely high profits (usually such investments are made in the sphere of the latest scientific developments, high technologies).

The country has also a "Technological Greenhouse" national programme - a network of incubators where start-up entrepreneurs with innovative technology projects receive the necessary financing, as well as all necessary infrastructure and administrative assistance. Two years later successful projects leave the incubator already being a commercial enterprise and having private investments [2].

However, it is a start-up who chooses an investor in this country but not vice versa. In Israel, for a number of years there has also been a system of government grants and subsidies for innovative start-ups. In addition, aiming to stimulate the development of the start-up industry, it is planned to create an Innovation Department under the Ministry of Economy [1].

Agrarian start-ups in Israel are aimed at creating favorable conditions for agricultural crops growing in the desert and include drip irrigation, fertilization using computer technology, etc. Since 1950 Israelis have discovered innovative ways of growing food crops in the desert. For example, in the southern lands 500 families have 10 acres of saline soil, from which each family exports vegetables to Europe for $ 0,5 million USD every year [3]. The organisers of the Vayyar startup announced the invention of a special chip which helps to observe the quality of the land irrigation [4].

Tal-Ya specialists have developed a technology that helps to get a bigger harvest with less water. Among the developments of the startup are: reusable trays for generating water from the air which reduce the need for water for growing crops by 50% and a square tray of recycled plastic. The innovative tray "surrounds" each plant and collects dew, which appears due to temperature differences during day and night. In addition, the tray (which can function up to 10 years) blocks the growth of weeds on the plantation. The products of the Israeli company are used by farmers in Israel, USA, China, Chile, Georgia, Sri Lanka and Australia. The NRGene start-up specialists are involved into the development of more resistant wheat varieties that can provide a higher yield [5] Thanks to the development of innovative technologies, one Israeli farmer can feed a hundred people.

At the end of 2016 Israel introduced the AgriTask platform for precision farming which will allow farmers around the world to benefit from the introduction of precision farming techniques and advanced agricultural technologies having no problems managing multiple technology systems. AgriTask can optimize the crops growing processes, meets the agronomic and management needs of various sectors of agriculture. AgriTask enables manufacturers to start using precision farming methods not changing the current work processes, for which ScanTask even created a special language for Android. The AgriTask platform helps users to prevent crop threats, protect crops, increase productivity and work efficiency, and save direct material costs from 18% to 40% [6]. This startup is used by 1000 farmers in Israel, Brazil, Peru, Colombia, Mexico, Kenya and Thailand.

In Israel, all conditions have been created for the effective development of the start-up industry: a quality education system, transparent tax policy, sound investment legislation, sustainable macroeconomic indicators and the highest level of confidence in the industry.

In Paris in the first half of 2016, the development of start-ups attracted more than one billion euros of start-up capital. This year they plan to establish the world's largest city of startups Station F., where 34 thousand square meters can accommodate up to a thousand start-ups (it must become the largest incubator in the world). One of the thousands of startups – Agricool is being developed

successfully in France. It aims to grow fruit and vegetables in containers in the middle of cities. For this, ideal conditions have been created: correctly selected lighting, temperature and humidity. As the products reach consumers very quickly, this method of cultivation requires seven times less resources than traditional agriculture (Agricool uses electricity only from renewable sources). The founders have already attracted four million euros from private investors to develop the start-up [7].

In Holland (Rotterdam) farmers organised a start-up Floating Farm, aiming to create the world's first floating dairy farm with a closed production cycle (total pontoon area – 1200 m^2). The farm will operate almost in an autonomous mode (it will be serviced by 2 employees). It is designed for 60 cows which will live on the top floor with a glass roof. The farm will have a floor made of artificial turf, real trees and grass for cows will grow on the ground floor. Wastes from intestinal fermentation will be collected by robots and used as a biogas plant fuel, which (together with solar panels on the roof) will generate electricity for lighting, machine operation and farm heating. It is planned to get about 1500 kg of milk per day. Private investors are ready to invest (2 million euros) in the development of this start-up as the profit is foreseen in the near future [8].

In Austria, the SmaXtec startup implants to a cow a devise that monitors the body temperature, activity and acid-base balance every minute. This helps to diagnose animal diseases at the early stages. The device with built-in hot dog size sensors is implanted to the animal in the first of four stomachs, the battery charge is usually enough for four years of use. SmaXtec invention connects to Wi-Fi and can text the farmers information about the state of the animal. SmaXtec cooperates with 350 farmers in more than 20 countries. Only in the UK there are about 15000 such devices, each costing from $ 75 to $ 400 USD [9].

A self-managed John Deere tractor that sprays fertilizer works on the farm fields near Hertfordshire (England). The machine is guided by satellite images and the history of harvesting of each site, it is equipped with a large number of displays. The tractor sends important data to the computer system of the farmer. Due to the fact that different programmes allow you to obtain information about weather, pesticide use and soil analysis and also to test plant tissue, a farmer can monitor in real time all that is happening on his farm without leaving the office [10].

In San Francisco, a start-up was established to grow agricultural products in an upright position. Vertical Plenty farms are rows of pallets with plants that extend to a height of 6 m. The startup grows rare varieties of basil, chives, mizun, lettuce, sorrel and other types of leafy vegetables. Plenty farms grow 350 times more than in fields or in greenhouses, using only 1% of water. Such indicators were achieved due to lower equipment and operation costs. Thanks to the development of machine learning, the Internet of things and digital systems for calculating utilities, it became even easier to organise work. Plenty also expects that over time, solar energy will supply the work of the farm.

Due to the isolation of farms, plants are minimally susceptible to parasites, so pesticides are not used to fight pests - it is enough to "hire" ladybirds. The development of the startup attracted $ 26 million investment from large funds. Startup plans to grow more tasty and diverse greens with greater efficiency but less cost [11].

For reference, in Shanghai a complex of vertical farms with an area of 100 hectares is going to be built; in the American New Jersey, the Aerofarms farm was opened with an area of 14,2 thousand m^2, which produces more than 900 tons of leaf plants per year (this productivity is comparable to 139,9 thousand m^2 of farming).

In India, Nubesol Technologies start-up has developed a WhatsApp type application for farmers, where they can communicate with eminent scientists in the field of agriculture and receive their recommendations, discuss factors of influence on the crop. In the Android version of the program there is also a function (RST), which helps to analyse the soil to increase the yield (for this you need to highlight the corresponding area on the Google map). In addition, the application helps to assess the condition of crops. The RST function is paid (it costs about $ 4 per year). The application is already used by 5000 farmers and about 100 requests are sent by it daily [12].

In addition to venture funds and business angels that invest in the development of start-ups abroad, innovative funds which were created on the basis of educational institutions play an important role. For example, in the United States universities operate large national centers specialising in

various scientific fields. Innovative activities are priority areas for research and development. An Association of University Technology Managers which collects and processes information, publishes a report on the activities of innovation funds in universities also functions in the United States. That means that innovative ideas developed and prepared by students are submitted to the center and can be implemented with the financial support of the innovation fund.

One of the alternative systems for attracting investment is crowd funding - a mechanism for attracting funding from the public with a view to realizing the idea or supporting the development of an already existing business, operates on a "every little bit helps" principle when those who wish can give some money for the project implementation. Crowdinvesting is one of directions of crowdfunding, where financial investments are given in exchange for a share in business [13].

Incubators and accelerators do not help gratuitously – these companies either take a fixed entry fee or they coudl ask for a stake in the company which they will help todevelop (from 5 to 20%).

Ukraine also develops and successfully introduces innovative solutions for agriculture, which are competitive in the world market. New technologies are actively used in both plant growing and animal husbandry. In the first instance these are: a system of farm-management, drones and robotics, innovative irrigation and irrigation systems, e-commerce in the sale of agricultural products. A significant number of agro-start-ups are aimed at researching and assessing the state of soils, which is new information which hasn't been always taken into account by agricultural producers until recently. In animal husbandry touch technology, security systems and animal control are used. The part of high technologies usage in the Ukrainian agrarian sector is about 10-12%, which indicates a low level compared to world leaders, where IT solutions in agriculture are used widely enough.

UA Berry start-up is one of successful Ukrainian innovative projects – aimed at growing strawberries all year round on mini-farms on an industrial scale, which has no analogues in the world at all. It is based on a programme that manages the cultivation process and analyses it. According to the strawberries growing technology, the climate control system in the greenhouse and the irrigation system (the node of the Fertigation) are fully automatic. The latest technologies are used for the climate control system – sensors operate over a radio channel and the system could be controlled remotedly via the Internet. At the same time, the accuracy of supply of mineral fertilizers is 98,9% – there are no analogues of such a system even abroad. This startup is designed for small commodity producers, as it does not require significant financial investments and large land plots. (Reference: the area where you can plant 132 bushes of strawberry and get an average of 50 kg of harvest, takes 6 m^2) [14].

In early 2016, the Ukrainian Ecorobotix start-up introduced a robot that struggles with weeds in the fields. The robot is equipped with cameras, which distinguish weeds from other plants, directs them to a mobile sprayer and produces a small dose of herbicides (it reduces its use in 2-3 times). The robot can orient in space through a GPS tracker and sensors, solar panels are located on the top of the device, it allows 12 hours of work without recharging [15].

It is noteworthy that examples of the successful functioning of projects aimed at establishing interaction between the agronomy developers and potential investors already exist in Ukraine. Thus, AGRO Startup Crash Test (AGRO SCT) project is focused on support of the development of start-ups in Ukraine. AGRO SCT is a set of regular informal events for entrepreneurs and representatives of agribusinesses, aimed at the development and support of innovations in the agricultural sector.

In the summer 2016 the AgroChallenge platform was established, aimed at investing in innovative projects in the agricultural sector. AgroChallenge provides for the creation of a business accelerator for investment and innovation projects, a grant fund for supporting innovative projects in the agricultural sector, the Agrarian Investment Fund and the Agro2027 Investor Club, an investment platform and a regular all-Ukrainian project competition in the agrarian sector [16]. The grant fund allocates money for the start-up development, which received a positive decision from the grant committee. Funds are allocated for projects, which are based on innovative, technological and business components.

In the near future, AgroChallenge will create a network of information and service centers for agricultural regions of Ukraine in close cooperation with farmers' communities. The centers will provide a full range of services in accordance with the needs of farmers in the field, deal with demand and farm

problems, perform educational and training work to improve the quality of projects for the business accelerator. It is expected that the centers will work according to the self-repayment model [16].

In Ukraine, a new investment fund for start-ups and IT projects has been created. It was founded by Concorde Capital - an investment company with a capital of $ 10 million USD. The capital was formed by both the company's own funds and external contributions and aimed at financing Ukrainian projects (the average investment size is $ 2 million USD) [17].

According to the Invest Europe Association, EU entrepreneurs invested about € 750,000 in Ukrainian start-ups in 2015, € 40,000 of it was invested in agriculture. According to the last year estimates, the foreign capital receipts in the agro-industrial complex 1,5 times increased [18].

The AgTech Ukraine association provides assistance to enterprising people in the creation of start-ups in agriculture. Within the framework of AgTech Ukraine targeted events are held; sites created where social networking sites, a website, electronic newsletters and announcements with demostands are displayed. Formation and promotion of content for AgTech Ukraine start-ups is free of charge. The AgTech Ukraine Association handles the situation on the market, it helps beginners to get on it and advises to investors. For agricultural enterprises, the entry into AgTech Ukraine is interesting from the point of view of searching for new ideas [19]. This association has all chances to become the main platform for the development of agtech market in Ukraine.

Incubators and accelerators are the instruments for finding investments including foreign ones, networking at conferences and thematic events. Despite all modern technologies, personal contacts are still one of the main ways for start-ups to get acquainted with investors [20]. The All-Ukrainian Agrarian Innovations Hackathon has been held in Ukraine for several years - it is a platform for innovative ideas at the intersection of agribusiness and IT-sphere, it helps to promote young start-ups and their ideas for agribusiness. During the meeting, developers present agrarian start-ups and debate with farmers, young enthusiasts, experienced businessmen, programmers, designers, marketers, engineers and other agrarian innovators. Experienced mentors help, criticise, prompt, share experience and answer questions from participants so that the latter can present their projects better not only in Ukraine but also abroad. The winners of the event receive monetary rewards, prizes from partners and marketing and consulting support from AgTech Ukraine. The Hackathon participants receive a significant push into the world of business and high technologies, as well as the opportunity to participate in a wide variety of conferences, exhibitions and other public events, presenting their own innovative developments.

In the summer of 2016 Svarog West Group and "KPI" University announced the beginning of a long-term cooperation in the development of innovative high-tech products for the agricultural sector with the involvement of faculty staff, researchers and technology park specialists [21].

At the end of 2016 AgroTalks agribusiness development platform introduced a specialized crawfinding platform for investment in agrarian projects – Donate Agro and Kraudinvesting platform – Invest Agro [22], which will attract financial resources (including credit) for the development of small and medium-sized business, young start-ups.

At the beginning of 2017 representatives of the agro-food sector, IT, retail, HoReCa, business education initiated the creation of the Ukrainian Food Valley aiming at uniting managers related to Agri & Food who are ready and able to move to a new way of thinking and acting from Frontal competition to cooperation. The mission of the Ukrainian Food Valley initiative is to create innovative food products and healthy food through the interaction of various players, to jointly promote Ukraine in the world and make it a global food leader thanks to the new generation strategies [23].

Organic farms – the agrarian start-up movement which is quite popular in Europe, is becoming widespread in Ukraine. Ecological farms open their shops and compete with large shopping centers. Products from the eco-farm are sold at not very affordable price but environmentally friendly products are in demand among consumers. One of the successful examples is the FishBuoy start-up for creating an intelligent buoy for fish farms, ponds and other water bodies. A fish buoy can provide the aquafarmer with information about the temperature of the water and its chemical parameters for determining the optimum time for feeding the fish and preventing contamination of the reservoirs, which leads to a saving of food and prevention of fish death [21].

Organic farms are developing throughout Ukraine, but the largest number is observed in its western regions. For example, in the Ivano-Frankivsk region. Owners of eco-farms while growing crops, take care of soil saturation with nutrients - by introducing compost from food and garden waste they create habitat for a huge ecosystem of bacteria, fungi and small organisms, helping to absorb carbon from the environment and keep it in the soil. Scientists and specialists in organic farming are confident that the small farms are the future of farming, as it is engaged in the cultivation of ecological products, restore soil and biodiversity, meet the growing demand of organic products consumers, etc.

Summarizing the above, it should be noted that the main resource for creating a startup is a successful innovative idea. Agrarian start-ups are rather widely created and successfully developed in foreign countries. Taking into account the above-mentioned experience of developed countries in stimulating the development of start-ups, it is necessary to introduce appropriate training in Ukraine for students who show initiative, desire and have innovative ideas for creating start-ups in the near future. It is suggested to introduce trainings for teachers of Ukrainian universities with the participation of lecturers from leading universities of the United States, Israel, the Netherlands, etc., where students' innovative ideas are successfully implemented. Agrarian start-ups in Ukraine need to be stimulated and developed in the future, as they have significant potential.

In order to disseminate information about agrarian start-ups in Ukraine it is necessary to:

– increase the number of All-Ukrainian agrarian innovations Hackathon, which will give greater freedom to introducing promising innovative ideas and will speed up the search for real investors;

– expand opportunities for providing information from start-ups at international exhibitions, conferences, competitions and thematic events;

– distribute information in the electronic resources catalogs, covering the experience of successful development of agrarian start-ups both in Ukraine and in the world;

– create profiles on social networks, where to place information on innovative ideas;

– create information blogs.

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