# COMBINED AGRICULTURAL PRACTICES INCREASING SECTORAL RESILIENCE TO CLIMATE CHANGE

## TECHNOLOGY DESCRIPTION

### TECHNICAL DESCRIPTION

Two major factors defining the future of agriculture development in Ukraine with regard to climate change impacts: (I) having the world's highest share of arable lands (about 72%) in the country's land bank and: (ii) the shortage of water resources. According to climate change forecasts, the temperature will keep increasing, and it is expected that the amount of insufficiently moisturized arable land will expand up to 25 million hectares (80% of total arable lands) by 2100. The desertification process will speed up while the maintenance of soil moisture will play a crucial role in adapting to climate change.

At the same time, there are two widely available ways to keep the soil moisture. The first one involves improving soil quality and decreasing evaporation processes. The second one refers to the application of irrigation technologies and means of delivering water directly. The first way includes measures such as mulching, application of conservation agriculture technologies, and others. These measures are affordable for broad users but often time-consuming to reach maximum efficiency, while immediate soil moisturization can be reached with the application of irrigation technologies. Considering the advantages of irrigation and agriculture's role in the national GDP, developing irrigation was accepted as one of the targets of the national economy strategy by 2030.

However, irrigation is quite expensive and resource-consuming, making it not affordable for the small and middle-sized farmers in Ukraine, the most numerous representatives of the farming sector. Moreover, available water resources are not enough to cover growing needs. Irrigation expansion might increase social tension around water use issues. **In this regard, implementing irrigation should be gender sensitive, as the significant share of rural households managed by the women.** Besides, one of the possible consequences of irrigation is the negative impact on soil and water quality, due to the development of water erosion and soil salinity.

The combination of sub-surface drip irrigation with conservation agriculture (DICA) avoids adverse effects on soil and improves natural resource use management, particularly water management. Furthermore, it increases production efficiency and, as a result, resilience to climate change. Additionally, this is a win-win technology that allows for both optimization of soil moisture and soil carbon management.

DICA technology consists of four key stages:

1. The first one is the creation of a proper crop rotation scheme including covering crops. The crop-rotation scheme is formed following the agro-climatic features of the farm, the agrochemical soil condition, and the economic feasibility of its cultivation for the farmer. Depending on soil-climatic needs and the specialization of a farm, crop rotations vary according to the composition and alternation of crops, the number of fields, and their size. Therefore, crop rotations are divided into types according to the production purpose and the cultivation of certain crops and sorts according to the ratio of crops.
2. The second stage is the installation of sub-surface drip irrigation. The installation of subsurface drip irrigation is combined with efficient water usage regimes. Implementing this technology requires the preliminary preparation and approval of project documentation for the irrigation system. In addition, it is subject to regulation by the Law on Environmental Impact Assessment No. 29 dated 18.12.2019.

3. The third stage is no-till soil processing through the use of specific types of machinery: seeding equipment for direct seeding technology with the appropriate predetermined design of the sowing coulter.
4. The fourth stage is moving towards integrated pest management principles.

Along with private investment, significant improvement is required for developing the technology within the national irrigation infrastructure, particularly pump-power facilities.

## CURRENT TECHNOLOGY READINESS LEVEL OR COMMERCIAL READINESS INDEX

Surface drip irrigation combined with conservation agriculture belongs to proven technologies optimizing the soil moisture and increasing resilience to climate change. The DICA is two climate-smart agriculture technologies ( Drip Irrigation + Conservation Agriculture) combined in one to complement each other and increase efficiency and resource consumption. A positive example of applying DICA can be found in Kherson oblast. It has been implemented over the last seven years by LLC Zorya-Yug. Significant contributions to DICA technology dissemination were created by developing the experimental plots by the Institute of Water Problems and Reclamation near the village Veliky Kline, Kherson oblast. Although the DICA has not been applied broadly yet, it has a significant positive potential to be developed in Ukraine, particularly in the arid and water-sensitive areas. The recent two years have demonstrated the fast-growing interest in conservation agriculture, including the No-till and its variation (mini-till, strip-till). The practices are successfully applied in many agricultural enterprises with various forms of ownership in different climatic regions of Ukraine ("Agro-Soyuz," Dnipropetrovsk oblast; "Agro-Myr," Kirovograd oblast; "Pischanka," Kharkiv oblast; farm enterprise "Beskydy," Rivne oblast, etc.). According to the latest approximate estimates, about 400,000 hectares of land are cultivated using conservation agriculture technologies.

The CA is attractive for farmers as a cost reduction technology besides its adaptation nature. However, some farmers refuse to use the CA itself because of the risk of lost yield in the short term after switching to the CA technology. Adding drip irrigation to CA practice would help to stabilize productivity and avoid loss in yield. At the same time, combined with CA, drip irrigation increases water and energy use efficiency and avoids soil salinity. Drip irrigation combined with conservation agriculture might maximize soil fertility even on the low productive lands. Irrigation itself considers the prospect of extending irrigated areas up to two million hectares in 2030 as it is foreseen in the National Strategy on Irrigation and National Economic Strategy. Meanwhile, the necessary equipment and machinery for setting up DICA are available through national (Agrosouse or Fregat) and international producers. On the other hand, there are state support programs for agriculture that already could cover (partial cover) the capital cost and, due to this, will stimulate DICA dissemination.

To summarize, the DICA has a high potential for dissemination due to (I) the growing interest of farmers, (ii) the available necessary equipment, machinery, and other inputs for the technology implementation, and; (iii) the existing state support, both financial and legislative. Moreover, given the technology potential to reduce emissions, the DICA might be attractive for green investments.

## CLIMATE RATIONALE OF THE TECHNOLOGY

The most likely consequence of climate change for Ukraine is the shortage of soil moisture content. This scenario is possible even in the case of the increasing level of precipitation. The temperature will grow and speed up the evaporation processes. The total soil moisture content may decrease by 15 - 20% compared to the current one, specifically in the Southern regions, even by 20-30%. Particularly it means that those regions which already suffering from droughts will not be suitable for agriculture without adaptation measures such as Kherson or Odesa oblasts. At the same time, the other territories will turn to the zone of high-risk agriculture (Kirovograd, Mykolaiv, etc.). At the same time, the waves of Heat that are projected to increase by a factor of 1.5 and long periods of heat (35 °C and above) will spread to the northern and western regions and cause a shortening of the length of the growing season of spring crops and reducing yield. On the other hand, climate change will cause changes in the precipitation structure. It is expecting the frequent appearance of heavy rain and rainfall over the country, strengthening land degradation processes, and lost land productivity under conventional agriculture.

The implementation of DICA technologies provides a set of benefits which increases the agriculture sector's resilience to climate change. The most obvious one is additional humidification leading to stabilized agriculture production during droughts and periods of water scarcity. In addition, DICA is a balanced approach to optimize soil moisture balance and reduce water consumption for irrigation needs. The implementation of this technology also helps improve soil quality, avoids the appearance of wind and water erosion, reduces plant diseases by 5 to 20%, and optimizes water balance and its quality in the regions.

At the first stage of TNA project implementation, the national experts on mitigation selected conservation agriculture (min-till) as the best climate change mitigation practice that contributes to carbon dioxide reduction. However, combining CA with sub-surface drip irrigation would double the mitigation effect.

## AMBITION OF THE TECHNOLOGY

### SCALE FOR IMPLEMENTATION AND TIME-LINE

Following the experts' estimation, DICA is efficient for application in environments with unsatisfactory agrochemical, physical, mechanical, and hydro physical properties, such as areas with high sand content, high content of dust and silt, compacted soils, low amounts of macronutrients, and low moisture content, particularly in steppe areas (Kherson, Mykolaiv, Odesa, Zaporizhzhya, Dnipropetrovsk, Donetsk, Lugansk oblast). However, increasing amounts of crop production losses due to droughts in forest steppe zones (Khmelnytskyi, Cherkasy, Vinitsa, Kirovograd, and partly Lviv oblasts) could accelerate DICA dissemination in the center and north of Ukraine.

Following the estimation performed under TNA project, the DICA technology might be scaled up to 695 thousand hectares over Ukraine by 2030. Approximately 400 midsize (which processed more than one thousand hectares) or big agriculture producers will be interesting in the technology implementation, mainly in the southern oblasts.

Considering the technology complicity and lack of relevant human resources, the DICA technology could be delaminated in a few stages with different levels of support. Based on the strong state and academic support, the technology implementation could be concentrated on the Kherson oblast for a couple of years. Once the positive working and education experience is reached in one oblast, it will promote and deliver technology to the other neighboring oblasts in the short term.

## EXPECTED IMPACTS OF THE TECHNOLOGY

In the most arid oblasts of Ukraine such as Kherson or Kirovograd, DACA application can increase cash-crop yield at least two times in a very approximate and average estimation.

Moreover, the application of DICA technology has additional economic benefits due to the reduction of labor costs by 1.6 times, equipment maintenance costs by 1.5 times, fuel by 2.2 times. Considering the costs of water, fertilizers, lime, herbicides and insecticides, and labor, the estimated savings of operational cost will be around 16%.

The long-term prospect of this technology is that it allows increases in soil organic matter content and humus due to the use of crop residue cover as organic fertilizer. Thus, farmers could reduce their expenses on fertilizer using the natural soil fertility and increasing the resilience to climate change in the natural “green” way.  The last advantage of

DICA technology is that the positive social effect refers to the more equal distribution of water resources among agricultural producers and the local population in terms of limited access to water resources.

# POLICY ACTIONS FOR TECHNOLOGY IMPLEMENTATION

## EXISTING POLICIES IN RELATION TO THE TECHNOLOGY

Following the Irrigation and Drainage Strategy in Ukraine by 2030 (GOV-CM 668-p.2019) and the Action Plan on the Strategy Implementation (GOV-CM 1567.2020.), the appropriate environment should be developed at the national level to scale up irrigation to 2,5 million ha. This goal is repeated as a critical national priority of economic development by 2030 (GOV-CM 179.2021). At the same time, joining the EU Green Deal and objectives determined in the Second NDC could stimulate farmers looking for more green solutions to move to the CA production, as the CA is defined as one among other recommended technologies. The other element of an enabling environment for the DICA technology development is the ongoing land reform in Ukraine aimed to provide ownership rights on land for farmers and make their investments in long-term agriculture technology more secure. Finally, the decentralization reform, which has been developing since 2015, shapes the new framework for natural resource management, including water and land management. It provides a unique opportunity to extend the implementation of adaptation technologies and increase climate change resilience not only of local communities but also farmers.

Given that increasing irrigation capacity is a critical component of national economic development for the next decade, the government is foreseen to extend state support for developing irrigation, with a total amount of 100 million UAH in 2021. Also, the other state support programs, with one compensating for 50% of expenses on the nationally produced machinery and another decreasing the loan interest rate, are increasing attractiveness to invest in DICA. Along with this, international donor organizations such as IFC (World Bank Group) and EBRD upscaled their intervention in developing irrigation capacity in Ukraine. Thus, the amount of irrigated area in 2020 was extended to 19 thousand hectares compared to 2019 and reached 551 thousand hectares. According to the annual working plan of the State Water Resource Agency, in 2021, the irrigated area will be increased up to 625 thousand hectares.

## PROPOSED POLICIES TO ENHANCE TECHNOLOGY IMPLEMENTATION

Despite the recent strengthening of the enabling environment for DICA development, the high capital expenses, insufficient legislation, and regulation basis in water and land sectors, a poor institutional mechanism to implement relevant legislation into the field level, and lack of qualified human resources pose significant barriers for the development of this technology.

Regarding this, currently developing regulation on land consolidation should prioritize the needs on the land consolidation for plots with existing irrigation and sustainable agriculture practices to further their extension. Additionally, enhancing the legislation towards the consolidated irrigation system construction and water management approaches will allow farmers to develop a shared irrigation system and infrastructure maintenance within one region.

At the present day, the state's financial support for farmers is framed by eight different programs. However, the support of climate change adaptation actions is not foreseen at the moment. Thus, it was recommended to focused on the next steps: (i) ***develop the gender sensitive system of indicators*** and baselines to reflect the progress of environment and adaptation for agriculture and local communities; (ii) to undertake water resources availability assessment by the oblast level; (iii) to improve the legislation towards the consolidated water management considering ***the needs of all members of society, including the vulnerable groups***, and: (iv) to strength the education activates to prepare the specialist for CA and irrigation including *the* ***interest of youth and women***. All this activates will provide farmers undertaking climateorientated agriculture practices with additional benefits and enhance the financial affordability for DICA and other climate resilience technologies.

Supplementary to institutional and investment policy lines, increasing the capacity of skilled human resources should be in focus. Launching field-based courses could encourage education ***of both mature farmers and the younger generation***. However, the relevant education courses for rural women require special attention. Considering that rural women are cut off from information, in part due to lack of time and also the logistical difficulties they experience in traveling to larger towns or cities.

## COSTS RELATED TO THE IMPLEMENTATION OF POLICIES

DICA is derived from the combination of conservation agriculture and irrigation, which defines the high cost required for technology implementation.

The acquisition of a subsurface irrigation system and the costs of its installation vary according to the country of manufacture and specifications (the price ranges between $1,800-$18,000 per hectare). The cost of the irrigation system depends mainly on the availability of its water source and the requirement for additional drill irrigation well. When drilling is required, design project documents, permits, and environmental impact assessments are needed, increasing technology implementation costs.

The other challenge is the purchase cost of the machinery required for conservation agriculture. The complex for sowing can range between $7,000-$40,000 per hectare and depends on the country of manufacturing.

Following estimates, the minimum capital investment required to satisfy the ambitions defined above is about 620 million USD by 2030, while the average amount is above one billion USD excluding the investment into the development of the national or local irrigation and drainage infrastructure.

# USEFUL INFORMATION

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## LINKS TO TNA REPORTS

| Report | Year | Link |
|---|---|---|
| TECHNOLOGY ACTION PLAN. ADAPTATION. UKRAINE (in progress) | 2021 | https://tech-action.unepdtu.org/country/ukraine/ |
| BARRIER ANALYSIS AND ENABLING, FRAMEWORK REPORT. ADAPTATION.UKRAINE | 2020 | https://rb.gy/atwsg4 |
| TECHNOLOGY NEEDS ASSESSMENT REPORT ADAPTATION. UKRAINE | 2019 | https://rb.gy/wx7fzs |