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Preface

We would like to present, with great pleasure, the inaugural volume-8, Issue-9, September 2022, of a scholarly journal, *International Journal of Environmental & Agriculture Research*. This journal is part of the AD Publications series *in the field of Environmental & Agriculture Research Development*, and is devoted to the gamut of Environmental & Agriculture issues, from theoretical aspects to application-dependent studies and the validation of emerging technologies.

This journal was envisioned and founded to represent the growing needs of Environmental & Agriculture as an emerging and increasingly vital field, now widely recognized as an integral part of scientific and technical investigations. Its mission is to become a voice of the Environmental & Agriculture community, addressing researchers and practitioners in below areas.

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Environmental science and regulation, Ecotoxicology, Environmental health issues, Atmosphere and climate, Terrestric ecosystems, Aquatic ecosystems, Energy and environment, Marine research, Biodiversity, Pharmaceuticals in the environment, Genetically modified organisms, Biotechnology, Risk assessment, Environment society, Agricultural engineering, Animal science, Agronomy, including plant science, theoretical production ecology, horticulture, plant, breeding, plant fertilization, soil science and all field related to Environmental Research.

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Agriculture, Biological engineering, including genetic engineering, microbiology, Environmental impacts of agriculture, forestry, Food science, Husbandry, Irrigation and water management, Land use, Waste management and all fields related to Agriculture.

Each article in this issue provides an example of a concrete industrial application or a case study of the presented methodology to amplify the impact of the contribution. We are very thankful to everybody within that community who supported the idea of creating a new Research with *IJOEAR*. We are certain that this issue will be followed by many others, reporting new developments in the Environment and Agriculture Research Science field. This issue would not have been possible without the great support of the Reviewer, Editorial Board members and also with our Advisory Board Members, and we would like to express our sincere thanks to all of them. We would also like to express our gratitude to the editorial staff of AD Publications, who supported us at every stage of the project. It is our hope that this fine collection of articles will be a valuable resource for *IJOEAR* readers and will stimulate further research into the vibrant area of Environmental & Agriculture Research.

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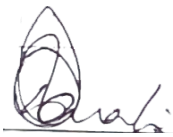

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Adsorption of cadmium ion on humic acid extracted from laterite soils of Kannur district, Kerala

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Abstract— *Humic acids are highly stable and functionalized portions of soil organic matter. Because of it's structural heterogeneity and surface porosity, it act as a catalyst in soil nutrient enrichment and palnt growth. Besides, humic acid sequestrate the heavy metal ions on it's surfaces by pore filling and multilayer adsorption. The study focused the structural behavior and the physico-chemical properties of the humci acid extracted from the laterite soils of Kannur district of Kerala. And evaluated the sorption performance of the humic acid with cadmium ion. Efficacy of the removal of the cadmium ion by humic acid will leads to an green technology for water purification and the sustainable use of the natural resources.*

Keywords— Humic Acid, Extraction, Infra-Red Spectroscopy, Cation Exchange, Capacity, Adsorption.

I. INTRODUCTION

The importance of humic substances are because of the organic carbon content and the effect on soil fertility, soil structure, water acidity, transportation and mineral weathering. Structural variety of this material directly influence the functioning on the soil [1]. Based on the solubility in different pH, the humic substances is classified into mainly three, fulvic acid (soluble in acidic and alkaline conditions), humic acid (soluble in alkaline condition), humin (insoluble in acidic and alkaline conditions). So the extraction of the material deals with the different pH of the extracting solution. From the three compounds, the highly stable and functioning material is humic acid. It is a dark coloured material. The role of humic acid on plant growth and soil nutrient capacity is extensively reviewed [2]. The structure of the humic acid consisit of carboxylic group, methenolic group, phenolic group and methoxy groups. The different carbon functionalities create a reaction potential to this molecule. The cation exchange capacity, total and carboxylic acidities and higher surface area are the unique properties of the humic acids. Effect of humic acid on plant root growth, plant growth hormone production, soil nutrient capacity and carbon cycle are documented by previous researchers. Highly porous and macro molecular structures of the humic acid help them to associate with other metal ion through adsorption on the surfaces [3]. Application of the material for environmental and agricultural purposes may increase the potential of the material. Instead of these, using a natural material like humci acid for impurity removal makes a green chemical approach.

The present study investigates the properties and structure of the humci acid extract from laterite soil of Kerala. The study monitors the cadmium ion removal efficacy of the humic acid and looking a forward technology for wastewater treatment.

II. MATERIALS AND METHODS

Soil samples were collected from Kannur district of Kerala. The soils were in laterite structure. Samples were collected from surface to the depth 20 cm. Uniformly mixed the sample and stored in clean bottles for analysis.

2.1 Humic acid extraction

Humic acid was extracted by adding 1 M NaOH and 6 M HCl for precipitation. Precipitated humic acid was purified by membrane vacuum filtration followed by dialysis against deionized water. Humic acid obtained after the purification was dried through freeze dry method. The samples for kept in moisture free atmosphere in clean and dried container.

2.2 UV-Visible spectroscopy

Optical properties of the humic acid was studied using Varian, Cary 5000 UV-Visible spectrophotometer with the range of 200- 800 nm. The sample was prepared by mixing 0.1 mg humic acid to 10 mL of 0.05 M $NaHCO_3$. Determined the ratio of absorbance at 465 nm to the absorbance at 645 nm (E_4/E_6).

2.3 Fourier Transformation Infra-red spectroscopy

Molecular spectrum of the humic acid was recorded using Thermo Nicolet, Avatar 37 infrared spectrophotometer. The sample was pelletized with KBr powder in the ratio 1:200 for sample to KBr. Spectrum was recorded with the resolution of 4

cm^{-1} in the range of 4000 to 400 cm^{-1}.

2.4 Elemental analysis

Elemental composition of the humic acid was determined on CHNS elemental analyser, Euro vector CHNS elemental analyser, E A 3000. Relative percentage of the carbon, hydrogen nitrogen was directly measured from the analyser. The percentage of oxygen was determined as the difference hundred with the sum of percentage of C, H, N and sulphur.

2.5 Physico-chemical properties

2.5.1 Cation Exchange Capacity

The cation exchange capacity of the humci acid from laterite soil was determined by barium acetate method. Measured the pH and conductivity at the final stage and calculated the amount of exchangeable cations.

2.5.2 Zero point charge

It was determined the zero point charge of the humic acid by potentiometric titration using 0.1 M HCl and 0.1 M NaOH solution on HANNA, HI901 autotitrator.

2.5.3 Total acidity and –COOH acidity

Total acidity and the carboxyl acidity(-COOH) of HA was measured by barium hydroxide titration method. The –COOH acidity was calculated by the potentiometric titration against calcium acetate. Phenolic –OH acidity was evaluated by the difference of total acidity and the –COOH acidity.

2.6 Adsorption

From the stock solution of Cd^{2+} ion, prepared at different concentrations as 5 ppm, 10 ppm, 15 ppm, 20 ppm, 25 ppm, 30 ppm, 35 ppm, 400 ppm. Added the approximate amount (1 mg) of humic acid to 30 mL of selected concentrations of Cd^{2+} ion solution (5-40 ppm) in a Eppendorf centrifuge tube. Experiment was performed at pH 4, 7 and 9 (adjusted the pH of the solution to 4 by adding 0.01 M HCl and 0.01 M NaOH solution) at the temperature 35º C for 48 hrs and the incubating shaker with a speed of 150 rpm. After 24 hrs, aliquot of the solution was centrifuged. Taken the supernatant and analysed on atomic absorption spectrophotometer to calculate the remained cadmium ion concentration after the adsorption. Determined the maximum percentage of Cd^{2+} ion adsorbed and the q_{max} from the following equations

$$\% \text{ of adsorption} = (C_0 - C_e) * 100 / C_0$$

$$qe = (C_0 - C_e) * V / W$$

where, C_0-initial concentration of $Cd^{2+\ ion}$ in ppm, C_e-equilibrium concentration of $Cd^{2+\ ion}$ in ppm, V-volume of solution in litre, W-weight of the adsorbent in mg.

III. RESULTS AND DISCUSSIONS

UV-Visible spectroscopy analysis provided the optical property of the chemical structure, whereas the involvement of chromophores (Fig. 1). It was observed the peak with monotonously decreased with wavelength. The ratio of absorbance at

645 nm to 465 nm, calculated as 2.95. Lower value range of E_4/E_6, indicated the stability of the material in it's existing form [4]. The FTIR spectru of humic acid consisted of major adsorption bands at 3400–3300 cm^{-1}, 2940–2900 cm^{-1}, 1725–1700 cm^{-1}, 1630–1600 cm^{-1}, 1460–1440 cm^{-1}, 1400–1375 cm^{-1}. These peaks were corresponded to the stretching vibrations of phenolic –OH stretching, C-H stretching of alkanes, C=O stretching of carboxyl groups, aromatic C=C stretching, deformation of C-H bonds of methyl group [5]. The molecular spectrum confirmed the structure of humic acid with the poly carbon functional groups. This heterogeneity of carbon functionalities, make the HA to ubiquitous and potential material in soil organic matter. The decomposition of soil organic matter at various stages caused this heterogeinity in it's structure.

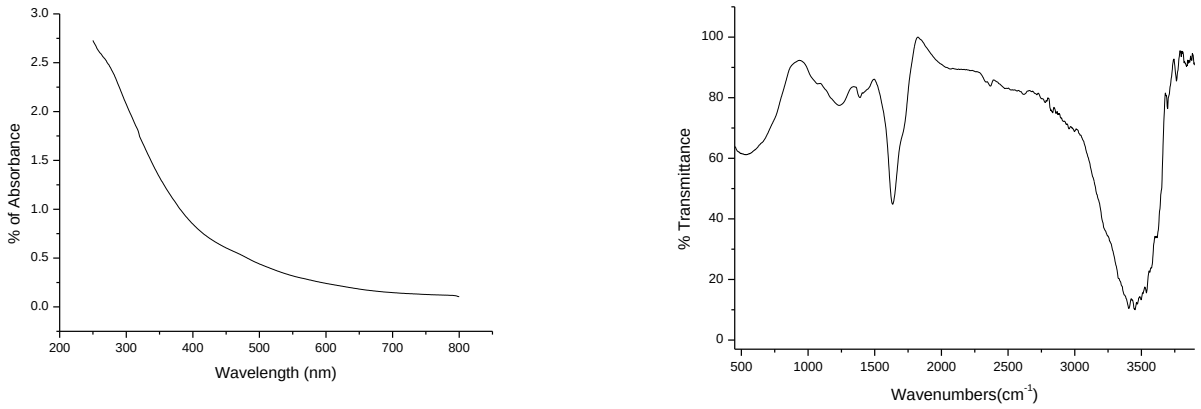

FIGURE 1: Spectroscopic characterization of the humci acid (a)UV-Visible Spectroscopy, (b) FTIR Spectroscopy

The elemental analysis of the humic acid from laterite soil was observed as 64.34 % of carbon, 4.27 % hydrogen, 27.47 % oxygen and 3.92% nitrogen (Table 1). The C/N ratio of the humic acid from laterite soil of Kannur observed with the value 16.41 and the O/C ratio calculated as 0.43. The percentage of carbon content was relatively higher than the reported values for humic acids [6]. It was noted that the humic acid extract from laterite soils were rich in carbon supra-molecular structures and may incorporate the reaction performance of the material.

TABLE 1
ELEMENTAL COMPOSITION OF HUMIC ACID EXTRACT

Humic acid extract from laterite soil	Elemental composition				Ratios	
	C	H	O	N	C/N	O/C
	64.34 %	4.27 %	27.47 %	3.92 %	16.41	0.43

3.1 Physico-chemical properties

Cation exchange capacity of the humic acid was observed as 473. 61 meq/100 gm (Tab. 2). The value of CEC predicted the efficacy of the material to exchange the inorganic ions a, thereby promote the soil nutrient capacity [7]. By binding with the clay minerals, to form organo-mineral complexes and perform wide varieties of duties to the soil systems. The zero point charge (ZPC) of the humci acid was observed as 3. 42. Above the pH of 3. 42, HA favors the positively charged ions (cations) and below this pH it favours the anion adsorption on it's surface [8]. Too acidic condition (below 3. 42) the net surface charge of the molecule is negative and attract to the positively charged species to it's surface and forms the bonding. The total acidity and the –COOH acidity were evaluated as 719. 09 cmol/Kg and 436. 28 cmol/Kg respectively. The component –COOH acidity, determines the ability to chelate with the ions by releasing H^+ ion and bind with the metal ions and the cations like Na^+, K^+ etc [9].

TABLE 2
PHYSICO-CHEMICAL PROPERTIES OF HUMCI ACID EXTRACT

Properties	
Cation Exchange Capacity	473.61 meq/100 gm
Zero Point Charge	3.42
Total Acidity	719.09 cmol/Kg
Carboxylic Acid Acidity	436.28 cmol/Kg

3.2 Adsorption studies

Adsorption of cadmium ion on humic acid from laterite soil indicated the potential of HA to heavy metal chelation (Fig. 2). It was observed that, percentage of adsorption of cadmium ion increase upto the initial concentration of 10 ppm of Cd^{2+} ion as 59. 73 %. Where the q_{max} was obtained for 25 ppm initial concentration as 212. 7 mg/Kg. The initial concentration increased, the percentage of adsorption increased upto the initial concentration of 10 ppm then decreased to 28. 56 % at 40 ppm of initial concentration of Cd^{2+} ion. When the pH of the solution increased from 4 to 9, the maximum percentage of adsorption was observed at 10 ppm initial concentration of Cd^{2+} ion and the values observed as decreased from 59. 73 % to 56. 27 % (pH 7) and 53. 28 % (pH 9). The value of q_{max} observed as observed for pH 7 and pH 9 were 192. 63 mg/Kg and 180. 22 mg/Kg. Observation of sorption behavior of the humic acid related with it's carboxylic acid functional group, which directly associated with the Cd^{2+} ions of the aqueous solution [10, 11]. The cation exchange capacity also catalized the adsorption mechanism of cadmium ion on the surfaces of extracted humic acids from laterite soils of Kerala [12].

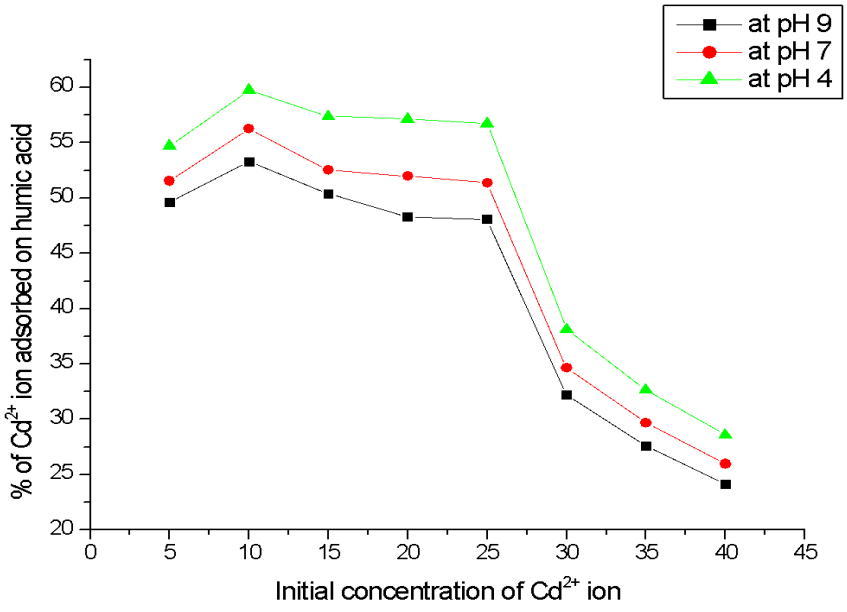

FIGURE 2: Percentage of Cd^{2+} ion adsorption on humic acid at different pH

IV. CONCLUSION

The humic acid extracted from laterite soil, Kannur is consisted with carbon function groups such as phenolic, carboxylic, ketonic and carbon ring structure. The stability of the material indicates the highly stable material with good cation exchange capacity and –COOH acidity. The supramolecular carbon dominated species have the potential to remove the heavy metal ion, cadmium. Lower initial concentration favours the maximum percentage of adsorption of Cd^{2+} ion and relatively higher initial concentration of Cd^{2+} ion leads the higher qe value. The percentage of adsorption and q_{max} are higher in the lower pH than the higher pH. As earlier reports of humic acids, the material from laterite soil always shows the same reaction performance as a sorbent. The results insights the pristine role of the humci acid in soil system to rich fertile environment.

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A Model and Plan for Bio-Dynamic Agriculture based on Agricultural Producers Group: A Case Study in Moldova

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Abstract— *The agricultural sector is in a dramatic situation in Moldova, a family-based economy.*

The recent situation created by the rising cost of non-renewable energy sources and their derivatives makes it necessary to re-examine the way of doing agriculture in Moldova. It is time to move quickly to the bio-dynamic model of agriculture.

Agricultural producers group improve the loan exchange of inputs and machinery, help improve education, reduce family poverty and information redundancy due to the creation of a mutual knowledge base and a high level of trust between members.

Providing a new perspective to the existing literature, this paper presents a Culture - Knowledge - Intelligence - CKI model that explains the impact of culture on knowledge and intelligence. The study concludes that culture change is necessary to farmers be open to learn modern agricultural practices and business language.

Keywords— Agricultural producers group, family farming, culture, knowledge, intelligence.

I. INTRODUCTION

The family is a central institution in agriculture (Stiglbauer and Weiss, 2000; Leonard et al., 2017, Bertolozzi-Caredio et al., 2020). This evidence is referred in the literature as intangible asset transfer (Grubbström and Sooväli-Sepping, 2012).

In addition, livestock production contributes 40% of the value added by the agricultural sector and one third of the protein intake of mankind (Steinfeld et al., 2006).

However, the livestock sector no longer exists in the Republic of Moldova and the family model of farming is in a dramatic situation for the following reasons:

1) There is a lack of basic education and, as a result, it could be assumed that farmers have limited knowledge about agricultural practices, such as new irrigation systems and trade-offs with alternatives to fertilizer production
2) Lack of access for farmers to the knowledge and experience concentrated in research institutes.
3) Farmers' failure to encourage young people to stay in rural areas without access to university.
4) Low availability and use of agricultural seeds
5) Very few examples of crop diversification and recycling
6) Very few agricultural producers group and training institutions,
7) lack of new mechanisms for farmers to communicate with investment banks and traders, as the economy is based on families and therefore farmers are not familiar with business language.
8) Farmers are reluctant to take out formal loans because they do not know how to fill in the documentation, because they have not received any offers or because they have no credit history and the lack of design of a viable agricultural insurance system.
9) There is no solid plan to recreate the livestock sector and integrate it with family farming.

This paper proposes a bio-dynamic FARMING MODEL AND PLAN for family farming in Moldova.

In order to understand how agricultural techniques should be created and applied in bio-dynamic Agriculture, a National Program of Technical Assistance and Financial Support for Family Farming is proposed to be implemented through local administrations and institutions.

The main objective of the activity is to stimulate the process of generation and application of new knowledge, paying particular attention to national and international cooperation in the field of Science, Education and Innovation, with the stimulation of research and training and the fixation of qualified and committed human resources in the local reality.

It is proposed to set up a bio-dynamic agriculture programme based on mentoring, best practices and lessons learned and mainly training courses to facilitate farmers' access to agricultural knowledge and information. When farmers are well trained, in a long-term perspective of the relationship between government and farmers, the quality of popular participation in agricultural projects will increase exponentially.

There are several issues of interest to family farmers. Most recently, the issues that deserve more attention are:

1) The need to expand studies on greenhouse gas measurement.
2) the strong emphasis on precision farming (more efficient use of inputs and resources, less carbon intensive production, etc.);
3) promotion of the development and widespread use of "land-saving"/resource-efficient technologies, making it possible to maintain the trajectory of reduced deforestation and expanded production.
4) comparison of irrigation techniques
5) re-creation of the livestock sector and integration with family farming
6) procedures to save and collect water
7) recycling and fertilization
8) advantages of crop diversification

Given these needs caused by the lack of understanding of culture's impacts, this paper presents a theoretical model to elucidate the relationships between national culture (values, beliefs and assumptions), knowledge management practices (creation and sharing of relevant knowledge) and organizational intelligence (interpretation and application of this knowledge). It is intended that this model, referred here as the Culture, Knowledge and Intelligence (CKI model), will serve as a starting point for further applied and empirical work designing bio-dynamic projects in the family farming sector.

This article is structured as follows. In addition to this introduction and conclusions, section 1 reports some best practices and lessons learned from bio-dynamic farming for the soil of Moldova. Section 2 explains the integration of knowledge management and organizational intelligence concepts and practices. Section 3 presents the topic of cultural intelligence together with the Culture - Knowledge - Intelligence - KIC model, combining the various theoretical elements gathered throughout the previous sections.

1.1 Best practices and lessons learned from bio-dynamic agriculture

According to World Wild Life (WWF), agriculture is the world's largest industry, employing more than one billion people worldwide and generating more than $1.3 trillion worth of food annually.

Morseletto (2019) argues that the so-called "green revolution" has been characterized by intensive agricultural practices in developed countries, where abuse of chemical fertilizers and pesticide use, monoculture production, intensive irrigation and deforestation have been common practices.

The green revolution has failed to catch on because it has greatly reduced production and productivity, without a balance with job creation and food subsistence, even within the household. This was due to excessive focus on the environment, without a balance with the community, livestock and marketing of part of the production.

An excellent alternative to industrial agriculture, also in decline due to excessive mechanization, chemical manipulation and use of herbicides, as well as disregard for environmental conservation, is bio-dynamic agriculture.

Bio-dynamic agriculture is a step ahead of organic farming because it takes a holistic, ecological and ethical approach to farming, gardening, food and nutrition, and is a way of living, working and relating to nature and agricultural vocations based on common sense practices, awareness of the uniqueness of each landscape and the inner development of each person and, consequently, of all practitioners within the community.

Bio-dynamic agriculture has its roots in the work of the philosopher and scientist Dr Rudolf Steiner, who opened up a new way of integrating scientific understanding with an awareness of the spirit in nature.

Crops are used for a variety of purposes, including human food, animal feed, bio-fuels and other non-food products (Cassidy et al., 2013).

Cover crops also contribute to farm fertility by adding plant diversity and bringing life and sentience to the soil through oxygen and nitrogen.

Crop rotation helps balance the needs of each crop and allows for creative diversity of expression in the soil. Together, these practices reduce or eliminate the need for imported fertilizer and allow the farm to move toward balance and resilience (Zaller, 2004).

Junquera et al. (2022) sustains that effective policies to support farm resilience, rural livelihoods and biodiversity will require a local to regional understanding of how farmers (re-)construct personal and professional social networks in changing rural socioeconomic systems and under increasingly competitive macroeconomic conditions.

Common sense practices include: striving to be self-sufficient in energy, fertilizers, plants and animals; structuring activities based on working with the rhythms of nature; using diversity of plants, fertilizers and animals in a healthy way; approaching work with seriousness, neatness, tidiness, focus on observation and attention to detail; timeliness in doing work (Steiner, 1993).

Campbell and Watson (2001) and Raupp (2001) found that soil improvement, within the bio-dynamic farming approach, is achieved through proper humus management - for example, by applying sufficient manure and organic compost in the best possible fermentation state; proper crop rotation; good soil functioning; protective measures such as wind protection; cover crops, green manures and diversified crops rather than mono-cultures; and mixed cropping so that plants can help and support each other.

Boris, Coșman and Chilat (2020) determined the amount of mineralized organic matter to obtain the expected yield of different crops in isolation with and without perennial grasses. Soil organic matter balance was determined by comparing the amount of mineralized organic matter for yield formation and the amount of newly formed organic matter (humus) from crop residues and manure. The authors propose a model to evaluate the provision of dairy cattle with forages and, concomitantly, the capacity of soils to compensate, together with gumanure, the mineralization losses of soil organic matter for the formation of the expected level of production (Boris, Coșman and Chilat, 2020).

The general rule is that soil-depleting crops, such as maize and potatoes in the field and cabbage, cauliflower, etc. in the garden, should alternate with soil-replenishing crops, such as those of the legume family (peas, beans, clover, etc.). Also, deep-rooted crops should alternate with shallow-rooted crops, and crops that require fertilizer should alternate with those that do not need it.

In this direction, a national policy and program of technical assistance for family farming, with implementation through local administrations and institutions, will benefit smallholder farmers through subsidized inputs and technical assistance (Mazhar et al., 2021), will help encourage improved farming practices through crop diversification (Nyantakyi-Frimpong et al., 2017), and new mechanisms for farmers to communicate with investment banks and traders, as well as social organizations (producer association) to facilitate participation in state-promoted programs and projects (Junquera et al., 2022).

In the direction of bio-dynamic agriculture, FAO (2021) found that sustainable agricultural practices can help reduce damage to ecosystems and help maintain food production despite climate change, extreme weather, drought and other disasters, as well as progressively improve land and soil quality (FAO, 2021).

In terms of fertilization, in addition to the amounts of nitrogen fertilizers (nitrates) that should be used, there are two other issues to consider: when and how to distribute them. The timing of the application of these fertilizers varies according to the crop and the climate, in particular the distribution of rainfall.

In terms of seed use, the main advantage of sowing is to save time and sow the seed at the right depth. Threshing is the method of detaching the grain from the straw or husk after the crop has been harvested. It can be done by hand or with a machine to separate all the grain seeds.

With regards to irrigation, it is noted that comparisons between irrigation infrastructures are rare in the literature, but the clear advantage of drip irrigation is the uniform delivery of water directly to each plant during the growing season according to the water requirements of each crop. Irrigation interval and frequency must be maintained as these vary from crop to crop.

Other advantages of drip irrigation over sprinkler irrigation are: 1 - Saving water and energy in pumping water and in the actual workload 2 - Possibility to apply fertilizer. 3 - Reduces the risk of weeds. 4 - Maintains soil structure and texture.

The main disadvantage is the initial cost. It is also important to note that drip flooding can occur.

In this respect, it is extremely important to be aware of the trade-offs in the ago-zoo-technical areas of family farming.

For example, in the absence of measures to restore soil fertility, irrigation contributes to the intensification of soil organic matter mineralization processes, with all the negative consequences.

It is, without doubt, the best irrigation technique for the type of soil in Moldova - a heavy clay loam CERNOZEMIC SOIL - to which is added the lack of rainfall, especially in summer.

One of the limiting factors for planting in CERNOZEMIC soils is the lack of nitrogen. However, it is possible to increase nitrogen in Moldova by biological means, returning perennial leguminous crops, especially alfalfa, to the soil to save the import of nitrogen fertilizer.

Qualifying and quantifying the soil quality problem for agriculture involves a number of knowledge areas and the need to pool experiences to propose solutions.

The two important technologies developed/under development in Brazil could be applied in this case of Moldova: the biological fixation of Nitrogen by rhizobia and the use of remineralizers.

Notwithstanding the soil quality problem and the techniques for supplying the necessary nutrients, Moldova must also mitigate the effect of weather conditions.

Agriculture is the main livelihood in most developing countries, but climate change has complicated agricultural production and food security (Ray et al., 2015). This has reduced crop yields by up to 60%, depending on crop, location and future climate scenario (Rose-nzweig et al., 2014; Asseng et al., 2015).

Greenhouse gas (GHG) emissions from agriculture (e.g. rice cultivation, enteric fermentation, manure and synthetic fertilizers), land-use change and forestry contribute to climate change.

It is essential that the Republic of Moldova starts to carry out more studies on bio-dynamic agriculture to enable guidance for family farmers, the main beneficiaries of this learning process and the win-win relationship with the government, private sector, research institutes, chambers of commerce and agricultural producers groups - GoPs.

This communication between researchers, development banks and family farmers can be achieved through the creation of GoPs which, in addition to addressing the issue of technical training, provide financial support to family farming initiatives. However, while the creation of GoPs is a good solution, people need to be educated in this, as well as in knowledge management practices, especially in terms of mentoring, best practices and lessons learned.

II. KNOWLEDGE MANAGEMENT PRACTICES

In general, scholars suggest that governments need to ensure that science is at the forefront of the strategy for economic recovery and economic growth. For them, science produces knowledge and therefore produces innovation, which improves quality of life, democracy, economic growth, and the ability to solve larger problems. However, Rothberg and Erickson (2004) hold that knowledge is static and ultimately, it only has value if people use it.

In 1989 Richard Ackoff established a simple taxonomy of environmental stimuli that has been widely adopted as concerns Knowledge Management - KM, holding that four classes of inputs exist for any system: data, information, knowledge, and intelligence (Ackoff, 1989).

Davenport and Pruzak (1998) made an important study about the differences among data, information and knowledge.

Data is a set of discrete, objective facts about events. In an organizational context, data is most usefully described as structured records of transactions.

Like many researchers who have studied information, Davenport and Pruzak (1998) describe it as a message, usually in the form of a document or an audible or visible communication. As with any message, it has a sender and a receiver. Information is meant to change the way the receiver perceives something, to have an impact on his judgment and behavior.

Most people have an intuitive sense that knowledge is broader, deeper, and richer than data or information.

Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers. What

this definition immediately makes clear is that knowledge is not simple. It is a mixture of various elements; it is intuitive and therefore hard to capture in words or understand completely in logical terms (Davenport & Prusak, 1998).

The transformation of knowledge into intelligence is an operation accomplished by the human capacity to interpret, analyze, integrate, predict, and act.

The information is analyzed in the context of the personal standards, criteria, and expectations of the decision-maker to become knowledge. Finally, the decision-maker applies this knowledge to a particular situation to create intelligence.

Rothberg and Erickson (2004) clarify that knowledge is socially constructed through collaborative activities, but access to this knowledge does not mean success in decision making, since knowledge without application is innocuous. In summary, knowledge is the foundation for intelligence, since intelligence is knowledge in action to solve problems.

Bali, Wickramasinghe, and Léaney (2009) define Knowledge Management - KM as a set of tools, techniques, tactics, and technologies designed to leverage the intangible assets of the organization by extracting data, pertinent information, and relevant knowledge to facilitate decision making. KM is a set of practices aimed at the interaction between tacit and explicit knowledge to acquire and create new competencies (knowledge + skills + attitudes) to enable an organization to act intelligently (transform complexity into meaningful simplicity) in different environments (Angelis, 2016).

Among all Knowledge Management practices the most adequate for the Moldova farmers are: mentoring, best practices, lessons learned. This is because many do not know how to relate outside their own families and do not give importance to the integration of the professional area with the intellectual area and this can be solved with mentoring sessions. It is also important to learn from best practices and lessons learned that can be shared by the various farmer groups.

The Republic of Moldova differentiates agricultural cooperatives from agricultural producer groups - GoPs, and focuses more on the latter as it is the priority of the Republic of Moldova's agro-industrial policy since 2013. These are producer groups that receive support for showing the necessary intelligence to achieve the proposed goal with financial and technical support from the state. However, some cooperatives can operate without obtaining the status of a recognized producer group - GoP, but they will not be able to obtain subsidies from the state.

The Law on GoPs and their Associations Nº 312 of 2013 defines a producer group as: any legal entity, excluding non-commercial organizations, formed by agricultural producers and recognized by the competent authority after a 5-year mutual learning process, whose main objective is the joint marketing of the agricultural products of the group members. They assume important functions and roles on behalf of their members. They can concentrate supply, improve marketing and sales, optimize production costs, conduct studies and research, and a wide range of other activities.

Individual farmers, on their own initiative, join together and establish a more effective marketing strategy, thus forecasting the competitiveness and value/price of their products. In this regard, by having producer groups recognized by the competent authorities, after submission of a recognition plan or an operational program, they can benefit from funds that can be invested by the members to achieve the established objectives.

In short, GoP is the special status granted by the MINISTRY OF AGRICULTURE, REGIONAL DEVELOPMENT, AND THE ENVIRONMENT - to business cooperatives that obtain the recognition license and implement the established operating plan for a period of 5 years.

Currently, according to the National Bureau of Statistics of Moldova there are about 3,550 registered cooperatives. Of these, only about 50 cooperatives are active, and 35 cooperatives have the status of producer groups - GoPs and can benefit from financial support measures (subsidies) from the state.

It is very important that farmers can better organize their joint purchases of agricultural inputs, marketing, storage, and processing through associations. These activities can ensure cost reduction and at the same time increase the added value of the products. The producer groups also benefit from the financial advantages offered by the state through subsidy programs. The fund is administered by the Intervention and Payment Agency for Agriculture (AIPA).

Thus, financial support is granted, at the request of the recognized producer group, by AIPA, and the interest on the loan is calculated by deducting the value of the production marketed annually by the producer group, according to the confirming documents, in descending order, as follows: 5% in the first year of activity, decreasing 1% per year until reaching 1% in the 5th year of activity of the producer group.

The financial support for the last year is offered after the confirmation of the correct implementation of the action plan.

A Schematic description of the process of creating a GoP:

1) Discussions within a circle of farmers with common views (producers of the same product or group of products).
2) Definition of goal by at least 5 farmers
3) Definition of purpose by at least 5 farmers
4) Founding of the Entrepreneurial Cooperative
5) 4-Registration of the Cooperative at the Public Service Agency of Moldova - asp.gov.md
6) 5-Drawing the necessary documents for the recognition process
7) 6-Submission of the application for recognition to the MINISTRY OF AGRICULTURE, REGIONAL DEVELOPMENT AND ENVIRONMENT
8) 7- Obtain recognition approval
9) 8-Implementation of recognition plan (5 years)

III. THE CULTURE-KNOWLEDGE-INTELLIGENCE MODEL

In an increasingly unpredictable and complex world (risks, breakthroughs and crises), a profound cultural change is needed in the areas of family ago-zootechnical farming, given the advantages of personal skills. This cultural change underpins the creation of a Strategic Plan for bio-dynamic Agriculture.

Under this plan, Agricultural producers group - GoPs, with the support of the Chamber of Commerce and research institutes, are tasked with organizing mentoring sections and sharing lessons learned and best practices, also through training courses with farmers to develop and integrate different intelligences: Cultural Intelligence - deal with complexity, strategic perspective, engaging communication, resource management and empowerment; Emotional Intelligence - Self-awareness, emotional resilience, influence and motivation; and Spiritual Intelligence - Intuitiveness, egolessness, trans-rationality and higher ways of knowing.

According to Miranda et al. (2017) it is worth emphasizing that the processes involving value changes, norms, and collective action are related to resilience in the sociological system and it is the exercise of cooperative learning that leads individuals, in the face of differences not only in behavior of an ecological nature, but also socioeconomic, and to an increase in resilience through collective action represented by the users involved in this system (Berkes & Ross, 2013),

Milagres et al. (2022) maintain that in the 2000s resilience became a central concept in sustainability science. Therefore, conceptualizing resilience as a skill, an useful way to deal not only with change, but also adaptation and transformation,

The international organization Resilience Alliance defines resilience as the ability of a system to absorb disturbances, to be modified, and then to self-organize while still maintaining its its identity, retaining the same basic structure and mode of functioning (Farrall, 2012).

In this sense, resilience is a perspective for analyzing social-ecological systems that emphasizes the need to understand and manage change, particularly unexpected change (Milagres et al., 2022).

Salanek Filho and Luiz da Silva (2006) found that the common goal of cooperatives is to promoting resilience and mutual growth of the whole community. They identified that 60 agricultural cooperatives showed a significant increase of 130%.

Due to their ability to create and apply collective knowledge, cooperatives have achieved amazing results in the process of local and national development.

Cooperative institutions can be found in various sectors of the economy, such as agriculture, health, credit, transport, education, etc. Of these sectors, the one with the best structure and which is given great national and international importance is agriculture.

Cooperatives have become a clear alternative for socioeconomic development, but critics argue that there is no methodological consistency to support such a claim, so they dismiss the research issue. Nevertheless, the gigantic potential of cooperatives to facilitate the creation, development, and accumulation of social capital through strategic actions that enhance mutual trust between cooperative members and then the exchange of goods, knowledge and experience within this collaborative environment is undeniable.

Interaction, trust, the definition of common goals and the structuring of the social network are essential aspects to understand the cooperative process and the relative importance of social capital for the development of the place where it takes place.

The idea of creating cooperatives in rural areas of the Republic of Moldova has enormous potential for the formation of social capital, as it promotes actions that aim to bring together not only the group of cooperative members but also the local community. However, the status of Agricultural producers group – GoP is an important step ahead in relation to cooperatives since it is a motivation for the farmers to develop an action plan with a purpose and related goals, a learning process with the government during 5 years.

GoPs have the function of providing services to their members, such as technology transfer, directed technical assistance, loan exchange of inputs and machinery between members, procurement of inputs, production of seeds and fertilizers, processing of other productions (storage and drying), transport and marketing.

The creation of GoPs depends on educating farmers in this respect and, as the culture is based on families with a very high level of mistrust, a cultural change is needed.

National culture affects organizational and societal behaviors, how people will act in a given situation, such as thinking and decision-making (Schein, 1985), and active knowledge management is essential.

In this sense, this article proposes a model that explains the impact of cultural change on Knowledge Management practices, applied in GoPs, and in the Proposal of a Technical and Financial Assistance Model for Small Family Farmers.

Figure 1 shows the bio-dynamic family farming model.

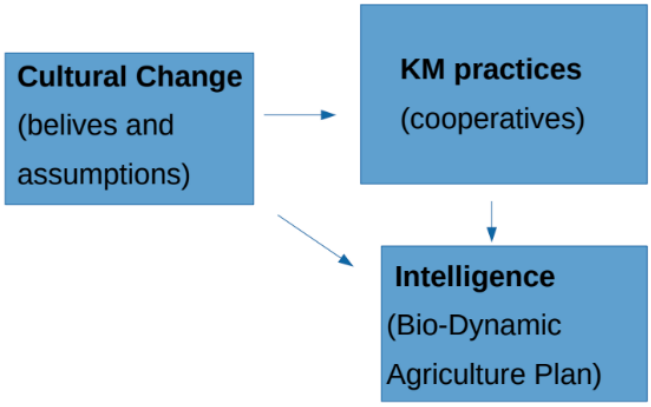

FIGURE 1: Biodynamic family farming model

The CKI model shows that the culture change of small family farmers has a positive impact on the knowledge management practices applied within cooperatives and also on the development and implementation of the Farmers' Technical and Financial Assistance Plan (intelligence).

Consistent with previous literature, the results of this study suggest that the development of an organizational culture (macro-level national culture) supports the application of knowledge management - KM practices (Davenport and Prusak, 2000; Nonaka and Takeuchi, 1995; Gold et al., 2001; Janz and Prasarnphanic, 2003; Lee and Choi, 2003; Donate and Guadamillas, 2010).

Some authors point out that organisational culture is not only a critical success factor for CM, but also the most difficult and important factor to address, especially if an adequate culture does not already exist (Davenport and Prusak, 1998).

However, changing a culture in an organisation or community is a formidable challenge.

The process of culture change encompasses the following requirements:

1) People must be willing to cooperate (there must be appropriate incentives and rewards);
2) Basic understanding of how CM can improve communication between farmers, academia, the private sector and government.
3) Networking to promote cultural change;

Culture also plays an important role in creating the conditions for learning with the internal and external environment. This research empirically tests three hypotheses (Table 1):

TABLE 1
ASSUMPTIONS IN THE CKI MODEL

Hypothesis	Source	Results
Cultural change has a positive impact on Knowledge Management (KM)	Many authors point out that organisational culture is not only a critical success factor for KM, but also the most difficult and important factor to address, especially if an adequate culture does not already exist (Davenport and Prusak, 1998).	SUPPORTED
Cultural change has a positive impact on intelligence	Culture affects organizational and societal behaviors, how people will act in a given situation, such as thinking and decision making (Schein, 1985).	SUPPORTED
Knowledge management (KM) has a positive impact on intelligence	Active knowledge management is essential to enable improved organisational performance, problem solving and decision making (Liebowitz, 2001).	SUPPORTED

IV. RESEARCH METHODOLOGY AND DATA COLLECTION

According to Miller and Glassner (2004), interviews are designed and executed to understand and give voice to participants' experiences, behaviours and attitudes in a non-threatening, confidential and non-evaluative manner. Interviews are particularly useful for getting the story behind a participant's experiences. The interviewer can pursue in-depth information around the topic (McNamara,1999).

We conducted the interviews based on individual interviews and compared and contrasted the results ourselves, avoiding focus groups because of their high potential for bias by consent (Schaffer and Riordan 2003).

The survey, available in the appendix, was conducted with the support of the Selecția Agricultural Research Institute, located in Balti, Moldova.

This research is based on a survey conducted in rural Moldova. A total of nine (9) interviews were conducted with family farmers**.**

V. RESULTS AND DISCUSSIONS

All farmers answered the first question with the option "I strongly agree". The same was true for question three (3) on Culture.

This protective behavior and also the awareness of the need to change the culture, by the time the farmers start to trust the new (pro-EU) government, are the result of the long and hard learning-suffering process with the Russian Federation fighting for the reintegration of Moldova on their territory.

This also explains the impact of culture on knowledge and intelligence as people in Moldova put much more emphasis on relationships and hard work and therefore usually have no time for technical knowledge. In this point, it is paramount to understand that the Russia Federation, that control the economy of the region through the the price of natural resources and agricultural commodities, created such economic crises and lack of talents in Moldova that the number of companies and wages are very low.

The reduced access to technical knowledge, which is part of the culture of the Republic of Moldova due to the persecutions of Russia Federation, leads to problems in the agricultural and livestock market.

Nevertheless, farmers have good practical knowledge, as seen in the "strongly agree" or "agree" answers to questions three and four (3 and 4) on Knowledge.

In addition, the majority of farmers consider the creation of Agricultural producer's groups – GoPs important, which is clear in the answer to question 3, topic culture (strongly agree or agree).

Organizational Culture - OC is basically a theoretical explanation for the means by which an organization accomplishes its objectives (Schein, 2004). However, even in those cases where upper managers have a strong awareness of the importance of Organizational Culture, there is often a lack of a deeper understanding of how organizations function in terms of culture (Adenfelt and Lagerstro, 2006, cited by Tseng, 2011).

On the national level, this research can facilitate the understanding of the impact of culture on society (micro-level: families and companies), the economy and the government (macro-level). Even some economists, with focus on solving economic problems through expansionist macroeconomic policies, have difficulties understanding the impact of culture on private organizations and governments.

Why, for example, Latin Europe, the famous PIGS club (Portugal, Italy, Greece and Spain), has economies based on tourism with the highest level of brain drain and therefore lack of talents.

The influence of national culture on behaviors is paramount to understand failures in decisions, mainly because of the difficulty of people to learn by comparison and collaboration from a global, participate and integrative vision and action.

Berry (1974) in his theory of cultural relativism holds that intelligence is a function of their cultural, social and ecological formation, suggesting thereby that intelligence is culturally bound.

Thus affirming **Hypothesis 1.**

In the interview on Culture, the vast majority of farmers, responded that they share their feelings and problems with family and friends in face-to-face conversations, which indicates the impact of culture on implicit knowledge. Explicit knowledge is not important to them as most of them are not in the habit of reading.

In the intelligence survey, they are aware of the trade-offs in the agro-family farming areas but cannot take appropriate action due to lack of financial and educational support.

Farmers want to see any signal from the government through financial or educational support. One farmer does not agree with the need for a bio-dynamic farming program. The other 8 farmers strongly agree with question 4 on intelligence.

The explanation of the farmer who denied the need for and contribution of an assistance program from the federal government in partnership with the local government and local institutions is that he got used to surviving without any help and does not trust the government, explaining also that the fee for obtaining loans to increase production is too high and involves a complex procedure.

They don't know about the procedure to create cooperatives and through a good project agricultural producers groups - GoPs and they also do not know the “Livada Moldovei Proiectul”, created by the European Union to support farmers. Livada Moldovei is a line of credit offered by the European Investment Bank (EIB) to the Moldovan government, which in turn grants this loan to participating commercial banks. The loans are earmarked for investments in the horticultural sector.

In addition, "systemic risks such as drought and frost", which particularly affect small farmers, putting their investments at risk, require the design of a viable agricultural insurance system, which is currently absent (World Bank, 2015).

It is clear that there is a considerable communication problem between the capital and the other regions of the country, as the federal government, as well as the local government, still does not know how to "enter" the homes of farmers and explain their initiatives to support them by creating a mutually beneficial relationship based on trust, order and progress. Farmers say the local government doesn't even have the money to collect garbage from rural areas. Because of the toxic rubbish, the plantations near the dump (an open area in nature) do not grow half as much as those a little further away, and the wind blows plastic bags, pet bottles and tins, even if in smaller volumes. The rural population of Bălți in the Republic of Moldova, does not want to complain to the City Hall and ask for a solution, because they consider that this situation with garbage is not relevant compared to the problem of the need for financial support, not to mention the need for technical assistance that most small farmers do not consider important.

Thus affirming **hypothesis 2.**

It is also clear from the interviews that the lack of production intelligence is not only due to the lack of financial support, as the farmers agreed. The problem of lack of knowledge is clear, especially for small farmers.

Gutiérrez et al. (2020) point out that deficient knowledge is an issue that limits tillage capacity and therefore a factor affecting soil degradation.

Caloghirou et al. (2004) state that the availability of knowledge will increase people's ability to search for, recognize and present a problem, and to assimilate and use new knowledge to solve problems.

Halal (1998) argues that intelligence is the ability of an organization to create knowledge and use knowledge to strategically adapt to its environment.

Thus affirming **Hypothesis 3.**

VI. A BIO-DYNAMIC PLAN FOR AGO-ZOO-TECHNICAL FAMILY FARMING AREAS

A systematic analysis of the family farming environment to identify the main trends, opportunities and threats is more than welcome.

Based on this review, the government should open new agricultural schools and promote campaigns to encourage people to study, with the help of the Chamber of Commerce, the Research Institute and Agricultural producers groups – GoPs.

As farmers reduce their social exchanges with neighbors and peers, they can use other sources of agricultural information and guidance, such as farm businesses, government offices, rural savings and credit banks, insurance companies, and educational and extension institutions - such as, in this case, the local agricultural college (Junquera et al., 2022).

It is very clear the need to establish a National Policy and a National Technical Assistance Program for Family Farming with implementation through local administrations and institutions, especially the Chamber of Commerce and Research Institutes.

This Program should include the rebuilding of the livestock sector with economic, organizational, educational and financial measures.

In this regard, the government should listen to farmers, and this can only be done through the creation of Agricultural producers groups – GoPs, which rely on sociology-educational events to transmit knowledge and intelligence to farmers. GoPs should receive knowledge from chambers of commerce and research institutes, which at present, due to the lack of GoPs, find it difficult to approach farmers.

In fact, low participation in social organizations (ex. GoPs) makes it difficult to participate in state-promoted programs and projects (Anang and Asante, 2020). Another point is the quality of participation and therefore knowledge management practices (mentoring, lessons learned and best practices), together with training courses, are paramount in this win-win relationship between government and farmers in a long-term perspective.

Another solution is the recognition of the essential role of diverse social contacts, local knowledge exchange and application, and cooperation in promoting the resilience of rural areas to global changes, by organizing on-farm events, creating spaces for spontaneous meetings or supporting various associations in rural areas (Junquera et al., 2022).

The European Union has developed a territorial cohesion strategy through a set of structural funds to reduce regional inequalities:

1) A balanced urban system through multiple centers (poly-centrism) and new forms of city-rural relations;
2) Equal accessibility to infrastructure and knowledge; (DINIZ, 2007)
3) Multi-level and participatory governance system between federal and municipal governments

In the same direction, the Federal Government of the Republic of Moldova should establish the National Policy and Program of Technical Assistance and Rural Extension for Family Farming.

Among other benefits, it should promote the creation of training courses, employment generation, induction of investments and implementation of social programs and projects, taking into account economic, social and environmental dimensions.

This national policy should focus on solving the problem of farmers' lack of access to knowledge and expertise, concentrated in research institutes, isolated farms and very few Agricultural producers groups – GoPs.

A national policy and a national technical assistance program for family farming, implemented through local governments and institutions, will benefit small farmers through subsidized inputs and technical assistance (Mazhar et al., 2021), will help encourage better farming practices through crop diversification (Nyantakyi-Frimpong et al., 2017), and new mechanisms for farmers to communicate with investment banks and traders, as well as social organizations (producer association) to facilitate participation in state-promoted programs and projects (Junquera et al., 2022).

The government is finding it difficult to access family farmers, especially in more remote regions, so the creation of new cooperatives and integration with existing ones will contribute to the adoption of the bio-dynamic farming model, as the techniques of this new model require training.

This training, like funding, should be seen as an investment and not an expense, because agriculture is the flagship of the economy and it is paramount to improve the communication between government and farmers and the education in the agriculture sector.

VII. LIMITATIONS OF THE STUDY

The interviews of only 9 families of farmers in the rural area of Bălți with low income and no easy access to public agencies in Chișinău, the capital of Moldova, can be considered a limitation of the study, since it would be interesting and important to also interview farmers from the middle and upper classes, especially those who have received the status of agricultural producer groups - GoPs.

Certainly, these are also impacted by the culture of distrust, since the new democratic government took power recently with policies of social participation and fighting corruption and war, but as they have already gone through a learning process with the MINISTRY OF AGRICULTURE, REGIONAL DEVELOPMENT, AND THE ENVIRONMENT from the five (5) years work plan, they can share the best practices and lessons learned with the smaller ones, thus helping to constitute their own GoPs or integrate the existing ones, depending on the technical contribution.

VIII. CONCLUSIONS AND RECOMMENDATIONS

The article clearly demonstrated through interviews and literature review that a cultural change among smallholder farmers would lead to the use of good knowledge management practices, especially mentoring, best practices and lessons learned. In addition, this cultural change would support the development and implementation of a technical and financial assistance plan. All of this is very clear in the Culture - Knowledge - Intelligence (CKI) model.

Small farms do not have communication with medium-sized farms because there is no place to exchange knowledge and experience, as well as machinery such as tractors, ploughs, harrows, spreaders and harvesters. One solution could be to set up cooperatives, and after Agricultural producers groups- GoPs , to help medium-sized farmers with fuel and running costs if they help small farmers with soil preparation.

GoPs would also be responsible for transferring relevant knowledge and opening credit lines for farmers.

In addition, we need to understand the countryside not only as an area of biodiversity and conservation of natural life, the ecological-environmental countryside, but also with the function of providing food, fiber and raw materials, the agricultural countryside, but also as a vocation for tourism, rural tourism still in its infancy.

To motivate this discussion and others, such as the best agricultural technique in terms of the Bio-dynamic Agriculture model, the paper proposes a National Policy and Program of Technical Assistance for Family Farming with implementation through local administrations and institutions will seek technical skills and expertise that contribute to a) technical-operational knowledge on irrigation, fertilization, etc.. ..b) the limitations imposed by soil conditions, in particular increasing the organic matter content in sandy substrates c) subsidizing inputs together with the design of a viable farm insurance system.

The outcome of the proposed National Policy and Technical Assistance Program will be the education of the farmers and better communication, mainly with academia and government, but also financial support.

IX. QUESTIONNAIRE ON FAMILY FARMING

CULTURE

1) I am aware that the values, beliefs and assumptions of family-based Moldovan culture have a strong impact on my thoughts and actions.
2) Despite all the advantages of family-based culture, mainly trust, I am aware that this culture makes me value less technical knowledge from the university and research centers about modern agricultural techniques, as well as business language for eventual marketing of products.
3) I am aware that in times of war it is necessary to unite with other families, as well as to understand the proposals and guidelines of the new and less corrupt government, and especially the knowledge produced by the research centers transmitted through the agricultural cooperatives. From this point of view, it would be important to promote resilience in rural areas through organizing events with farmers, creating spaces for spontaneous interaction by supporting an educational-social association in rural areas, a cooperative.

KNOWLEDGE

1) I am aware of the limiting factor for planting on CHERNOZEMIC soils is the lack of nitrogen and a good start would be the gradual return of alfalfa with plant biomass fermentation through methanization with bio-gas and complement with perennial vegetable crops.
2) I would like to be an even more independent farmer and for that I am open to training courses (new irrigation systems and trade-offs with alternatives to fertilizer production) that make it possible to integrate scientific understanding with an awareness of the spirit in nature and business language to find financial support.
3) I am thoroughly familiar with various home farming techniques such as composting fertility, animal integration with agriculture, cover crops and crop rotation.
4) I am fully aware that the rule of thumb is that soil-depleting crops, such as maize and potatoes in the field and cabbage, cauliflower etc. in the garden, should alternate with soil-replenishing crops, such as members of the legume family (peas, beans, clover etc.).

INTELLIGENCE

1) I know that life can only be understood backwards; but it must be lived forwards, being aware of why I do what I do.
2) I develop a sense of self that is not the result of ideas or views or opinions or experiences, but it is beyond character – it is the natural way of living that everyone is heir to.
3) I have the ability to review all our previous thoughts and experiences in a new context and perspective, "reading" the finer and deeper causes of things.
4) I think it is necessary a National Program of Technical and Financial Assistance for Family Farming, with implementation through local administrations and institutions. This Program will benefit small farmers through subsidized inputs and practical technical knowledge.

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Effect of Organic Manures and Inorganic Fertilizers on Growth and Yield of Chickpea (*Cicer Arietinum L.*) under Moringa Agroforestry System

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Abstract— *The field experiment was conducted in Rabi season during November 2021- March 2022 to find out the effect of organic and inorganic manure on growth and yield of Chickpea (Cicer arietinum L.) at research field of College of Forestry, SHUATS, Prayagraj, UP. The experiment is laid out in Randomized Block Design (RBD) consisting of 9 treatments replicated thrice. Various treatments. Result revealed that at 30 DAS interval maximum plant height (19.44cm), at 60 DAS interval maximum plant height (50.65cm), at 90 DAS interval maximum plant height (56.51cm), at 30 DAS maximum number of branch (4.73), at 60 DAS maximum number of highest number of branch (9.87) and at 90 DAS maximum number of branches (12.27), at 70 DAS the highest 50% flowering% (77.87), at 70 DAS highest number of pods per plant (no.) (41.13), at 70 DAS the highest number of seeds per pod (no.) (2.73), after harvesting the highest test weight (100 seed, hundred-seed weight) (gm) (31.33), after harvesting highest grain yield q/ha (20.67). after harvesting highest straw yield q/ha (19.33), after harvesting the highest harvest index % (48.67) and maximum benefit cost ratio 1:70. While maximum gross return (121847.5) and maximum net return (76,828). The highest recorded in the Treatment T9 (NPK 100% + FYM 100%).*

Keywords— Chickpea, NPK, Farm Yard Manure, Growth, Yield.

I. INTRODUCTION

Cultivating agricultural crops and trees together is an ancient practice world-wide. Agroforestry refers to the sustainable land use systems involving trees combined with arable crops or animals on the same unit of land in some form of spatial arrangement or temporal sequence. Agroforestry is recognized as one of the supreme strategies to attain ideal multiple benefits, through interactive and intentional land use system and technologies where trees are deliberately planted with agricultural crops or with animals. In India, it has been a traditional practice and has received greater emphasis in recent years as a sustainable land use option of high potential. In agroforestry systems there are both ecological and economical interactions between the different components **(Lundgren and Raintree, 1982).** Agroforestry systems have been designed to fulfill the economic, social and cultural needs of the local population, while keeping an eye on the ecological balance. To increase the economic importance of the tree component, the multipurpose tree species (MPTS) have been introduced in agroforestry systems. The multipurpose trees are those trees and shrubs having more than one preferred use, product and/or service.

Moringa oleifera is a fast-growing, drought-resistant tree of the family Moringaceae, native to the Indian subcontinent. Common names include moringa, drumstick tree It is widely cultivated for its young seed pods and leaves, used as vegetables and for traditional herbal medicine. It is also used for water purification. Although listed as an invasive species in several countries, M. oleifera has "not been observed invading intact habitats or displacing native flora", so "should be regarded at present as a widely cultivated species with low invasive potential.

Chickpea *(Cicer arietinum L.)* It is an important pulse crop with synonym Bengal gram, garbanzo (Spanish), chana (Hindi) and chanaka (Sanskrit). It is the largest produced food legume in South Asia and the third largest produced food legume globally, after the common bean (Phaseolus vulgaris L.) and field pea (Pisum sativum L.). India is the largest chickpea producing country accounting for 64% of the global chickpea production. The other major chickpea producing countries include Pakistan, Turkey, Iran, Myanmar, Australia, Ethiopia, Canada, Mexico and Iraq. It is grown in an about 30% of the

national pulse acre which contributes to about 38% of national pulse production in India. The total production of this crop has increased from 3.65million tonnes in 1950-51 to 5.77 million tonnes in 2003-04 registering a quite low growth rate of 0.58% annually in the area under cultivation (a decline from 7.57 to 7.29 million hectares) with an increased productivity from 482 to 792 kg/ha, the global chickpea area was about 11.0 m ha with a production of 8.8 m tons and average yield of nearly 800 kg ha-1 **(Gaur et al., 2010).** Pulses occupy a very important place in Indian diet because they constitute the major source of protein to the predominantly vegetarian population Nutritionally, Chickpea is relatively free from various anti nutritional factors, has a high protein digestibility, and is richer in phosphorus and calcium than other pulses. Because of its higher fat content and better fiber digestibility, chickpea holds good promise as a protein and calorie source for animal feed. Chickpea straw also has a forage value. Because of these diversified uses of the crop and its ability to grow better with low inputs under harsh edaphic factors, it is an important component of the cropping system of subsistence farmers in the Indian subcontinent.

II. MATERIAL AND METHODS

The materials, methodology and techniques adopted during the course of the investigation entitled, **"Effect of Organic manures and Inorganic fertilizers on Growth and Yield of Chickpea (*Cicer arietinum L.*) Under Moringa (*Moringa oleifera*)** based Agroforestry System", Location: The experiment was carried out during *Rabi* season of 2021 at Crop Research Farm, Department of Silviculture & Agroforestry, College of Forestry SHUATS, Prayagraj (U.P.) which is located at geographical coordinates of 250 24' 42" N latitude, 810 50 56 E longitude and 98 m altitude above the mean sea level. This area is situated on the right side of the river Yamuna by the side of Prayagraj. Prayagraj is situated at an elevation of 25.26° N, 81.54 E, and 98 m above the mean sea level. It is located in the south-eastern part of Uttar Pradesh and has a tropical to sub-tropical climate with extremes of summer and winter. During winter month especially Dec- Jan temperature drops down to as low as 5° C while in summer, temperature reaches above 45° C. Hot scorching winds (commonly known as Loo) is regular feature during the summer whereas there may be an occasion's spell of frost during the winter. The annual rainfall is about 1100 mm mostly during the monsoon autumn i.e. July- Nov with a few occasional showers during winter months. Soil texture was sandy loam.

III. RESULTS AND DISCUSSION

3.1 Growth attributes

Growth parameters are Plant height, Number of branches, Days to 50% flowering. the analysis of data revealed that significant difference was found in plant height at 30,60 and 90 DAS The data maximum plant height at 30DAS was Recorded In T9 (19.44) followed by T8 (19.12) similarly, and minimum plant height was recorded In T1(17.01) and at 60 DAS The minimum plant height was recorded In T9 (50.65) followed by T8 (49.49) similarly, and minimum plant height was recorded In T1(46.59) significant and at 90DAS The maximum plant was recorded In T9(56.51) followed by T8(56.17) similarly, and minimum plant height was recorded In T1 (52.95) data similarly Significant. That significant difference was found in Number of branches at 30,60 and 90 DAS. The data maximum Number of branches at 30DAS was Recorded In T9(4.73) followed by T8(4.53) similarly, and minimum Number of branches was recorded In T1 (2.93) and at 60DAS The maximum Number of branches was recorded In T9 (9.87) followed by T8 (9.67) similarly, and minimum Number of branches was recorded In T1 (7.67) significant and at 90DAS The maximum Number of branches was recorded In T9 (12.27) followed by T8 (12.07) similarly, and minimum Number of branches was recorded In T1 (10.27) data similarly Significant. Days to 50% Flowering at 70DAS have presented in table no 4.3 and fig 4.3 the analysis of data revealed that significant difference was found in Days to 50% Flowering. The data maximum Days to 50% Flowering was Recorded in T9 (71.87 followed by T8(73.07) similarly, and minimum Days to 50% Flowering was recorded In T1(76.87) data similarly significant.

3.2 Yield attributes:

All yield parameters are Number of Pods per Plant, Number of Seeds per Pod, Test weight, Grain yield, Straw yield. Number of Pods per Plant at 70 DAS the analysis of data revealed that significant difference was found in Number of As per Plant. The data maximum Number of Pods per Plant was Recorded In T9 (41.13) lowed by T8(40.80) similarly, and minimum Number of Pods per Plant was recorded In T1 (37.80) data similarly significant. that significant difference was found in Number of Seeds per Pod. The data maximum Number of Seeds per Pod was Recorded In T9 (2.73) followed by T8(2.47) similarly, and minimum Number of Seeds per Pod was recorded In T1(1.07) data similarly significant. Test weight (100 seed, Hundred-Seed Weight) (No). The data maximum Test weight (100 seed, Hundred-Seed Weight) (No) was Recorded in T9 (31.33) followed by T8(30.67) similarly, and minimum Test weight (100 seed, Hundred-Seed Weight) (No) was recorded In T1 (27.00) data similarly Significant. Grain Yield. q/ha. The data maximum Grain Yield. q/ha was Recorded in T9 (18.33) followed by T8

(17.67) similarly, and minimum Grain Yield. q/ha was recorded In T1 (14.00) data similarly Significant. Straw Yield. q/ha. The data maximum Straw Yield. q/ha was Recorded in T9 (19.33) followed by T8 (19.00) similarly, and minimum Straw Yield. q/ha was recorded In T1 (15.00) data similarly Significant.

TABLE 1
EFFECT OF ORGANIC MANURE AND INORGANIC FERTILIZERS ON GROWTH ATTRIBUTES OF CHICKPEA (AT 90 DAYS) UNDER MORINGA AGROFORESTRY SYSTEM

	Treatment Combinations	Plant height	Number of branches	Days to 50% flowering
T1	NPK 0% + FYM 0% (control)	52.95	10.27	76.87
T2	NPK 0% + FYM 50%	53.82	10.6	76.07
T3	NPK 0% + FYM 100%	54.2	10.87	75.53
T4	NPK 50% + FYM 0%	54.49	11.2	75.2
T5	NPK 50 % + FYM 50%	54.99	11.6	74.53
T6	NPK 50% + FYM 100%	55.66	11.8	73.8
T7	NPK 100% + FYM 0%	54.63	11.4	74.93
T8	NPK 100% + FYM 50%	56.17	12.07	73.07
T9	NPK 100% + FYM 100%	56.51	12.27	71.87
	F. test	S	S	S
	C.D	1.22	0.2	1.17
	SE(m)	0.41	0.07	0.39

TABLE 2
EFFECT OF ORGANIC MANURE AND INORGANIC FERTILIZERS ON YIELD ATTRIBUTES OF CHICKPEA UNDER MORINGA AGROFORESTRY SYSTEM

	Treatment Combinations	Number of Pods per Plant	Number of Seeds per Pod	Test weight	Grain Yield. q/ha.	Straw Yield. q/ha.	Harvest Index %
T1	NPK 0% + FYM 0% (control)	37.8	1.07	27	14	15	47.07
T2	NPK 0% + FYM 50%	38.27	1.27	27.67	14.33	16	47.24
T3	NPK 0% + FYM 100%	38.6	1.47	28	14.67	16.67	46.79
T4	NPK 50% + FYM 0%	38.87	1.67	28.33	15.33	17	47.51
T5	NPK 50 % + FYM 50%	40	1.73	29.33	16.67	18	47.98
T6	NPK 50% + FYM 100%	40.33	2.07	30	17.33	18.33	48.24
T7	NPK 100% + FYM 0%	39.6	2.27	29	15.67	17.67	47
T8	NPK 100% + FYM 50%	40.8	2.47	31.33	17.46	19	48.14
T9	NPK 100% + FYM 100%	41.13	2.73	31.33	20.67	19.33	48.67
	F. test	S	S	S	S	S	NS
	C.D	0.63	0.2	2.13	2.44	2.2	5.93
	SE(m)	0.21	0.07	0.71	0.81	0.73	1.98

IV. CONCLUSION

The study entitled **"Effect OF Organic Manures and Inorganic fertilizers on growth and yield of Chickpea (*Cicer arietinum L.*) under Moringa based agroforestry system"** it was concluded that the treatment combination T9 (NPK 100% + FYM 100%) was found to best in term of Growth and Yield. (Treatment 9) recorded significantly higher Gran yield (kg/ha). It could be recommended for cultivation of Chickpea.

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