

A NEW PROFESSIONAL FOR SUSTAINABLE AGRICULTURE. THE CHALLENGE IN MEXICAN ENGINEERING EDUCATION FOR RURAL DEVELOPMENT

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Abstract: Promoting sustainable agriculture that respond to the challenges of mitigating and adapting to climate change, which contributes to reducing poverty, exclusion and hunger, demand a new professional of agricultural engineering and rural development, with a new professional profile, values, skills, attitudes and capacities to promote changes that rural society demand. Based on analysing the rural reality of developing countries in general, and Mexico in particular, specifies the elements that must give way to the new profile, discussing their integration as citizens of a globalized and multicultural society, in a world becoming more complex, and that it operates under multiple trends and directions. Emphasis is placed on the advantages and disadvantages of promoting education for sustainability and rural development exclusively through transversal content. The research is based on interviews and evaluations of the authors, made a number of educational programs in Mexico, to identify aspects that favour or limit the formation of this new professional to respond to new challenges in higher education for rural development; as well as new capabilities that teachers must acquire to promote it.

Keywords: rural development education, sustainable agriculture, knowledge, skills, competences

Introduction

The course of the agricultural engineering curriculum proposals on rural development in Mexico has been changing and irregular, according to the phases of neoliberalism, the paradigm shift and the priority that the Mexican State gives the agricultural sector and agricultural higher education. Currently, the higher education institutions in Mexico have adopted a policy of accreditation and evaluation of the quality of its programs, making continuous improvement processes are one of the main tools for quality assurance.

In essence, the agronomist in rural development is a trained professional to: develop management plans and meet production technological processes of various agricultural commodities; formulate and implement research projects in various areas of the rural sector, as part of globalized agriculture and social welfare criteria for producers and sustainable development. Ready to operate, manage and work in multidisciplinary teams, implementing, coordinating, evaluating and managing projects related to the promotion of rural development processes.

Moreover, while we agree with the deep criticism of the way in which, in many cases, Rural Development programs are designed and implemented, we believe that more important is to reflect on the current and real possibilities of social change that can offer new professionals, which is important to point out new trends, emerging practices, paradigms and opportunities facing these professionals, as well as new challenges, skills, abilities and attitudes that shapes the educational programs at the level higher education. Therefore, we analysed different programs of study and reflect on the results obtained by a group of managers from different agricultural engineering academic programs in rural development in Mexico.

The objectives of this work are to establish the principal elements to consider in the curriculum of the academic programs in agronomy in rural development, and identify the challenges that derive into the responsibilities of the universities that offer these types of programs.

Methodology

The contents of the paper is based on a comparative analysis of various texts and documents which defines the objectives, competencies, graduate profile and fundamentals of various academic programs

agronomist's career in rural development, which are taught in Mexico, with the purpose of identifying new challenges that must be considered in the training of these programs. Similarly, considering the results of the Symposium "Rural Development: teaching and praxis", held at the University of the State of Morelos, Mexico, in May of 2012, in this event, involving 12 Mexican higher education institutions offering educational programs in rural development engineering, which discussed and analysed the problems, approaches and challenges each face in the light of new paradigms, trends and requirements demanded by society in terms of rural formation.

To complete the study, we performed a theoretical analysis and evaluation of the scientific literature, methodological and different documents, as well as the reflection of the personal experience of the authors in the field of higher education in rural development.

Results and discussion

Considering the major emerging themes that will define the agenda of rural development, the collective of the Symposium "Rural Development: teaching and praxis", held at the University of the State of Morelos, Mexico, in May 2012, identified as the main emerging Practices in Mexican rural society (Hewitt, 2007; Robles, 2007; Análisis del..., 2011):

- the influence of the global food and agriculture policies in the local spaces;
- promoting development processes based on participatory design methodologies for problem solving based on the real needs of producers;
- use of interdisciplinary and systemic approaches to address environmental problems, to learn the complexity and diversity of the ecosystem management;
- encourage the empowerment of producers and their organizations;
- promotion in managing business and family enterprises;
- promote processes under the approach of the "new rurality" and territorial development;
- promotion, vindication and revalorization of traditional agriculture, rural capacities and rural lifestyle;
- enhancing the role of rural women and the importance of non-farm livelihood;
- promotion of organic farming and traditional products and denominations of origin;
- an increasing awareness that hunger, poverty and the environment are intimately related, so it is not enough just to define development policies only in terms of meeting needs;
- the most influential agents in the realization of development policies are producer organizations, especially the traders;
- planning with democratic participation at local government level;
- it is recognized that the technological backwardness is one of the main constraints to increased productivity;
- the services offered to producers must be of quality, timeliness, transparency and profitability;
- greater complementarity of agricultural activities and non-farm income generating and temporary migration;
- claiming of peasant demands by way of mobilizing;
- increased participation of farm products in economic strategies for price stability;
- integration of productive chains;
- promotion of public policy for the reconversion;
- induction of a culture of quality and safety in food production;
- capitalization will field through attendance of public and private resources in the context of a self-advocate rural society.

This, allows to identify, than in the agronomic field are experiencing a change of paradigm, which largely reflects the change of the paradigm of the "green revolution" (the agricultural industry model) to the "blue revolution" (Pauli, 2010), and that is reflected in the boom of plasticulture, precision planting, integrated control of pests, weeds and diseases, and biotechnology, agroecology, permaculture, sustainable agriculture, urban agriculture, among others, along with the decline, degradation and pollution of natural resources that make up a new context and a different agronomic reality.

The technology that exists now has generated two types of society: knowledge and information, it is based on technological advances in communication, it's quality and speed management of information become a key factor of competitiveness (Olive, 2005), the former incorporates the social, ethical and political influence in the development of communication and its technologies.

There are a number of obstacles that limit the full arrival of sharing knowledge societies: the digital divide today not connected to the network means being deprived of access to multiple knowledge, the knowledge divide, much deeper and older, that divides countries and societies, the concentration of cutting-edge knowledge and investments in the fields of science and education, promotes brain drain (Hacia las sociedades..., 2005).

Edgar Morin (1999), indicates that it is necessary in the education: teaching the brain processes and modalities of human knowledge and culture, which can establish the degree of error or illusion of knowledge to address certain issues in a comprehensive manner, to thereby locate local problems and partial; promote individual awareness about the human condition (for the individual, physical, biological, psychological, cultural, historical and social); promote knowledge about the identity of the individual earthly, identifying who you are, where comes and where it goes, and the role of the group in which they work and society; teach uncertainty managing it properly as permits take risks, the unexpected and uncertain; promote understanding, to prevent racism, xenophobia and contempt among individuals and groups, and it is necessary to study the incomprehension from their roots, patterns and effects.

The training of professionals should rest on the incorporation of higher levels of knowledge, promoting teamwork, ability symbolic interaction, extensive knowledge of the production process, development of innovative thinking and proactive and the construction of reviews and propositional attitudes (Olmeda, 1998), promotion of values and attitudes directed to the benefit of society, its environment and its people. Engineering Education (Hanel, Taborga, 1992) should be considered attitudes toward work and society: sustainable development awareness, honesty and professional ethics, productivity, quality, entrepreneurship and capacity of adapting to change. Consideration and respect for cultural, environmental and ethical issues involved in their work, and leadership (Yadarola, 1999).

The professional field of food and agriculture, according to (FAO, 1993), should have a solid ethical and humanistic education based on the principles and values of discipline, perseverance and hard work, honesty, honesty, punctuality and responsibility, love of truth and justice, respect for others, a spirit of loyalty, mutual aid and solidarity, initiative and creativity, permanent desire for improvement, openness to change and innovation. Flexible, eclectic, realistic, pragmatic, creative, witty, critical, with positive attitude, humble, with effective skills in written and oral communication.

Higher agricultural education in Mexico, facing rapid changes in the world and difficult to assimilate them, which leads to the modification of these, tuition reduction, consolidation of self-employment, fragmentation and isolation of the curricula, teaching information and detached from the realities of production, lack of competitiveness, sustainability and equity in training (Marco de..., 2001). The training of professionals should rest on the incorporation of higher levels of knowledge, promoting teamwork, ability symbolic interaction, extensive knowledge of the production process, development of innovative thinking and proactive and the construction of reviews and propositional attitudes (Olmeda, 1998), promotion of values and attitudes directed to the benefit of society, its environment and its people. Engineering Education (Hanel, Taborga, 1992) should be considered attitudes toward work and society: sustainable development awareness, honesty and professional ethics, productivity, quality, entrepreneurship and capacity of adapting to change. Consideration and respect for cultural, environmental and ethical issues involved in their work, and leadership (Yadarola, 1999).

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pragmatic, creative, witty, critical, positive attitude, humble, to communicate effectively in both written and oral.

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Moreover, the emergence of the so-called blue revolution, demand new approaches to agricultural production, including agriculture for sustainable development, agroecology, permaculture, etc. in addition of the prospective of agricultural production, indicating the permanence of intensified agriculture, the need for further training of human resources, retention for open economies, employment in private enterprises and self-employment, as well as increasing the planning, management and agricultural research. The presence of niche opportunity and the low availability of land and water, low investment in the field, need for greater efficiency in the management and use of water, pollution of natural resources and low labor availability.

This situation demands a competitive agricultural education, quality and excellence, with priority to the formation of the student and where practice plays a key role. To achieving that kind of education can select between three models: the dynamic spiral, the multiple intelligences and the skills.

The spiral model is dynamic which could more easily reach the formation of the student, then manages ten dimensions of personality: the sensory-motor, emotional, mysticism, rational thinking, logical, ethical and aesthetic, the causal and spiritual. The multiple intelligences model, aims to address the human dimensions through: truth, beauty, morality, the rational, logical and instrumental. The competency model addresses student training through the rational and logical, which combines theory and practice (Badilla, 2005), is integrated into the globalization process, is supported by various agencies, and boom goes Mexican education increase.

The powers in Europe, is designed to train and evaluate intelligence and predict the success of managers. In the 70's and 80's of the last century and millennium teacher training and competency based business attracted great interest, some educators as Skinner, Mager, Maslow and Rogers were inclined skills training, as well as supporters of the humanistic approach, both schools were accused of a lack of interest in social issues, however, the skills approach to teacher training, allowed to develop more elaborate profiles. This success coupled with the fact that Japan, a country with inventive and great production and generation of new products, owned several organizations working under the scheme of powers, prompting many organizations to adopt that system (Mulder, 2007).

Over time the concept changed from economics to education (Moreno, Soto, 2005) and became more complex, accounting knowledge, know-how, knowledge be, undertake knowledge, of knowing how to live in community and knowledge teamwork, re-know the value of multiple sources of knowledge and personal experience, prior learning of each individual, imagination, art and creativity (Pinilla, 2005).

Competencies have several functions in the education system: are relevant in the discussion of degrees, diplomas and skills relevant to the knowledge economy, the world of knowledge is not enough, it also requires competition; allows recognizing acquired skills in-formal, in order to promote lifelong learning and to address the shortage of qualified people; allows current generations to achieve better performance in their jobs.

The competency-based approach responds to the need of people to make things even better, promotes the integral development of the human being seeks to respond to new forms of work organization under and integrate these in training programs, promotes greater autonomy of the students and teachers makes tutors (Mulder, 2007), seeks to promote learning environments, implementing educational models focusing on the performance (Diaz Barriga, 2006), for each level of competition considered domain (beginner, novice, intermediate, expert and master) and the degree of complexity (start, practice, focus and domain), which facilitates their implementation and evaluation.

The competence profiles that differentiate graduates should handle existing professions, promotes mobility between educational levels, identifies the elements to improve to exercise particular profession, puts into action the knowledge acquired in certain contexts, and that the student is able to

circumvent new situations from a practical conceptual framework previously acquired (Romero, 2005).

Areas of opportunity competencies are: a tendency to lower mastery of basic skills, the knowledge, skills and attitudes are fragmented, the development of skills is given in very general terms, we present a disconnect between competition and performance, and the difficulty of how to determine whether or not developed a competition (Mulder, 2007). Diaz Barriga (2006), challenges the concept of competencies contribution towards education, considering that already had built the term knowledge training and skills development; indicates a lack of conceptual thinking, because there is no clarity on how the approach Competency can be applied in higher education, has few theoretical and pedagogical contributions, also requires clarifying their own language containing its proposal and limits.

The skills are acquired through an educational process determined, and allow the individual to solve the problems inherent to the object of their profession in a particular work context, including the anticipation of problems, evaluating the result of the work and the ability to participate actively in improving production (Levy-Leboyer, 1997). Those powers up the expertise and knowledge to be, involve knowing how to use, require some experience and a relevant consider the context in which competition takes place (Tejada, 2005; Malpica 1999, Hager, Beckett, 1999), have character unit because its elements are meaningful only under set (Malpica, 1999) and have an appropriate level of generality (Hager, Beckett, 1999).

The new paradigm for sustainable development must question the old styles of development, not only for its immobility and little benefit to developing countries but also that 75% of cases have failed in Latin America and the Caribbean (Souza, 2005). Marketing is the bottleneck in production also means about 50% of the profits, so that should be implemented various forms of presentation and marketing of agricultural products, as the form of sale is through intermediaries.

Professional Skills agronomist

Taking as reference so far described professional skills, and some of the activities to be performed on them, the agronomist, are grouped into technical, methodological and social participation, and are as follows: *a) the Technical skills; b) Methodological competences; c) Social Skills participatory.*

The Technical skills. Establish, implement and evaluate the various crop production techniques to reduce the problems of the production process and maintain the resources involved in the process. Some of the activities to be performed are: establish the current and potential market for the products and by-products of crops or to implement, select (s) kind (s) to grow, making the preparation; implement methods of plant propagation, determine the type, source and method of use of nutrients to use, troubleshoot plant stress; apply the methods or harvest or crops, and postharvest handling techniques applied to agricultural products and byproducts depending on the particular market.

Making efficient use of water for agricultural purposes, seeking to conserve and increase the ground water table and improve the use of surface water in order to increase agricultural production. Some of the activities to be performed include: assessment of crop evapotranspiration, assessment of water quality, design or selection of the most efficient irrigation method, design and evaluation of irrigation and drainage, and evaluation of groundwater levels and the cost of pumping water.

Conserve, restore and optimize the agricultural land, seeking to reduce erosion, pollution and degradation to sustain and increase agricultural production. Some of the activities to be performed include: development of diagnostics on the agricultural situation of soils, application of methods and techniques for the improvement and recovery of degraded soils two, using methods of soil conservation tillage; assessing the degree of contamination of water used and suggestions on ways to clean up the same.

Select and use agricultural machinery and equipment, to make more efficient use and increase agricultural production levels without adversely affecting natural resources. Some of the activities to be implemented are: selection and evaluation of machinery and equipment according to the crop, its stage and environmental conditions; planning and evaluation of the requirements of spare parts and

maintenance of machinery and equipment according to their use and production units, characterization of tractors in terms of their power and use, proper repair agricultural machinery and equipment.

Diagnose, monitor and prevent weeds pests and diseases that occur in crops in order to increase production without harming the environment. Some of the activities to be performed: morphological, physiological and contextual pests, weeds and diseases, implementation and evaluation of techniques and methods for the prevention and control of pests, weeds and diseases.

Methodological competences. Analyse, implement and evaluate various strategies of sale and marketing of agricultural products and byproducts to improve the profitability of production and offer better quality products for consumers. Some of the activities to be implemented are: characterization of the current and potential market of agricultural products and byproducts; morphological, physiological and organoleptic quality of the products and by-products of agricultural production, characterization of the various forms of packaged-do of products and agricultural products; chains strategically analyse product crop system implemented, implementation of sales strategies and marketing of agricultural products and byproducts; conservation financial analysis, sales and marketing of agricultural products and byproducts.

Managing companies and projects that seek to increase agricultural production levels and quality of agricultural products and by-products, as well as the conservation of natural resources. Some actions to implement are: search, select and integrate information for planning, organization, evaluation and feedback from companies and projects and provides the potential risks; applied methods and techniques for the development of enterprises and projects; evaluates the company's financial analysis and value judgments on them and proposes how to address the deficiencies.

Establish, implement and evaluate energy alternatives derived from agricultural products that are economically viable and environmentally sustainable to help reduce the problem of energy supply. Some of the activities to be implemented are: assessment of the energy potential of agricultural products or byproducts.

Social Skills participatory. Design, implement and evaluate various strategies for rural development, looking for the benefit of rural society and the conservation and enhancement of natural resources. Some of the activities are to develop, manage resources and programs, formulation and evaluation, organization and training of producers and implementation and evaluation of rural development models. This means the implementation of various forms of communication and a form of group and individual work.

Conclusions

- The XXI century University is called to meet the educational, scientific, technological and cultural demands of society, conform and representing a dynamic force to be engaged citizens that society demands, under a free spirit, democratic, humanistic and critical . But to accomplish any great university is necessary to generate a common impulse through participation and dialogue, to set up a free university, innovative, participatory, tolerant and governed by the principles of commitment to society they should, search quality and academic excellence.
- The challenges and the challenges facing rural society in Mexico, demand for agricultural universities and their academic programs, new attitudes and new commitments. The future positioning of the university must be based on strengthening its role as educator of citizens into an institution responsible for the generation and dissemination of knowledge, an inexhaustible source of creativity, innovation and entrepreneurship, and in promoting the education and advocacy values of our society, and where research is understood as the systematic search for answers to the questions posed by the reality; allow better use of their results, and enhance, at the same time, the solution of social and productive demands.
- Of agriculture depends food security, concept that alert to the serious risk that countries are producing food waives their peoples. In the context of a global economy, the overwhelming market forces make it essential and critical depth analysis of the current model of rural production, to find one that leads us to ensure food production and international integration without major trauma.

- Hence, universities should provide answers to questions such as: what we produce and how we do it? Reconciling sustainability, productivity, profitability, competitiveness and fairness, to exploit and conserve biodiversity, food needs and raise the living standards of farmers groups.
- No productive sector can survive a crisis such as multimodal and permanent agriculture suffering. In this complex and globalized world wealth is no longer measured only by the possession of financial capital and natural resources, but by the production, generation and management of knowledge and information.
- The university as a social institution created to knowledge and academic reflection cannot hide and develop without making commitments. The contributions of the university depend on its strengths, and its action is most effective when facing social problems and which seeks to address labor and have been linked to concrete realities.
- If agricultural universities do not assume a more involved role in the problems of rural society, its graduates definitely will not and should also be alert to the growing trend of turning knowledge into a commodity, subject to market rules and ethical considerations outside of their work, their origin and role of rural society expects of them: a nearby college to the real world, their demands, challenges and needs.

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