Social impact of research in the Rodas municipality, Cuba. Case study in the Agro Industrial Processes Degree

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ABSTRACT

This paper covers the social impact of scientific research in the Agro industrial Processes Degree in the Municipality of Rodas, Province of Cienfuegos, Cuba, in the 2012-2013 period. The main results achieved are associated to a three-stage procedure: diagnostics, impact measurement, and result assessment. The first stage includes a municipal characterization and classification of research by topics and local bodies, based on a set of tools created for that purpose. The second stage measures the social impact of research in the location. It includes variables (research in context, knowledge and innovation of applied results, and impact of research management in the municipality). Additionally, it considers a set of indicators for each variable. The third stage comprises result assessment of each variable and indicator. The procedure was validated by expert´s consensus, and guarantees assessment of appropriateness, viability, and applicability, which provides local governments outline scientific and management policies according to the needs and priorities identified in the location.

INTRODUCTION

Funds for the promotion of research and innovation in local social systems have increased every year. Along with the increase, the need to achieve useful results with social impacts require a redirection in research, development and innovation to support decision making in terms of science and technology (Milanés, Solís, Navarrete, 2010).

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Impact assessment is both a global and national issue. Since the first attempts to assess education and training programs, assessment procedures have gained methodological complexity, and have pushed for relevant spaces, to become indispensable for project transparency concerning the results and functioning (Fernández, 2001).

Impact awareness embraces the concept of measurement per se, and leads to the issue of proper indicators (quantitative and qualitative), to measure from the desired dimension, show temporary evolution, and detect strengths and weaknesses to set up strategies (Itzcovits, 2001, Estébanez, 1998).

In Latin American and Caribbean countries, both governments and important private actors, acknowledge the importance of science for social and economic development. Today, in those countries there is major consensus about the importance of having reliable and updated information on science, technology and innovation. The science, technology and innovation indicators are essential tools to assess impact and to define policies. Accordingly, they have an important position in the scientific and technological agenda of the local countries (Albornoz and Martínez, 1998).

Cuba is now making an effort to recover its economy, and is counting on the contribution of science to foster exports, replace imports for domestic goods, or make tangible contributions to society, the environment and the scientific production. To achieve that, it is important to have a system that provides the required information for decision making, concerning which programs and strategic projects must receive the limited funds (Partido Comunista de Cuba: Lineamientos de la Política económica y social del partido y la revolución, 2011) the country has.

The efforts made in Cuba in terms of scientific result impacts, and their assessment, puts the country in a better position regarding scientific indicators, moved by the reality and necessity to measure impacts. It is a significant step toward assessment of efficiency and potentiality of the system.

In Cuba, universities play a key role in the production of scientific knowledge socially. The social mission of science in universities is especial in that it gives students the intellectual capacities, the methods, and the tools to become professionals through scientific research.

Cuban higher education considers science as a creative activity, a priority of universities that must be oriented, promoted and developed in order to stimulate knowledge in favor of society. In that regard, the university is a space to train competent professionals, with a commitment to their social environments (Cuba, Ministerio de Ciencia, Tecnología y Medio Ambiente, 2009).

Assessment of scientific results in universities, based on indicators that include economic and social impacts, is an invaluable piece for decision making nationally and locally, for the economy, politics, strategic planning, assurance, infrastructure, and particular areas of science development. Particularly, impact

measurement of scientific research on local development is an important issue nowadays, as it contributes to social improvements. Besides, several decisions can be made in terms of local scientific policies.

This topic has been discussed and evaluated, but needs further analysis. Ortiz (2015), highlights that the impact of scientific research done in universities has been poorly assessed on a systematic basis by teachers, professors and executives.

This research has been explained by several previous works, including Martell (2014), Fernández de Castro and Shkiliova (2012), and Hernández and Rodríguez (2013). Each paper deals with methodologies or procedures derived from stages, which make possible research impact measurement, as well as result assessment in a particular location.

The authors have matching criteria, concerning the definition of variables and indicators used in the said procedures. Each variable has a defined set of variables that facilitate assessment of scientific impacts on the solution of the local social problems. The main flaws are consistent with the presentation of specific results of certain indicators, and assessment of local development during application. On the positive side, the suggested indicators help assess scientific research impact on integrated local development.

This paper describes a procedure to assess the impact of scientific research on the Agro industrial Processes Degree, at the University of Cienfuegos, in the 2012-2013 period.

The antecedents are found in research done by Hernández and Rodríguez (2013), Negrín and Rodríguez (2013), Rodríguez, Carranza and Sotolongo (2013), Hernández and Santana (2013), Bermúdez, Comas, Sardui, Macías, González and Vara (2013), Capote and Padilla (2013), Fernández de Castro and Shkiliova (2012), and Martell (2014).

Negrín and Rodríguez (2013), Bermúdez, Comas, Sarduy, Macías, González and Vara (2013), Capote, Padilla and González (2013) are working separately on a methodology to assess the impact of research, from stages and steps comprising diagnostics, variable and indicator identification, impact measurement, and result assessment. Hernández and Rodríguez (2013) suggest diagnostic and result assessment, and consider the inclusion of other two: design and validation of indicators. Hernández and Santana (2013) made six stages: diagnostic, assessment identification, variable design and validation, variable and indicator calculations, effectiveness assessment, and analysis of results. However, Rodríguez and Carranza, and Sotolongo (2013) coincide with them in the difference used for research identification, variable operationalization, and impact assessment.

The definition of variables and indicators that can be used in the above mentioned procedures varies according to the author. Hernández and Santana

(2013), and Negrín and Rodríguez (2013) coincide in the pertinence and implementation of research as variables that contribute to impact assess. The latter add efficiency and efficacy, and they, Rodríguez, Carranza and Sotolongo (2013) also identify specific indicators for every area of knowledge researched.

Bermúdez, Comas, Sarduy, Macías, González and Vara (2013), and Capote, Padilla and González (2013) classify the variables of economic impact as economic-financial, also depending on their relevance and contribution. These authors define a set of indicators for each of the variables proposed that allow measuring the impact of research.

On the contrary, Hernández and Rodríguez (2013) put together research impact variables, as to: research association with the current reality, knowledge and innovation during implementation of research outcomes, and research management impact of the university degree in the location. All the variables comprise a set of indicators that make possible to assess pertinence, effect and impact of results, with a manifest contribution to the solution of local problems.

MATERIALS AND METHODS

A procedure to assess the impact of scientific research in the municipality of Rodas, Cienfuegos, Cuba, is described in this paper, as part of graduate thesis dissertation of students in the Agro industrial Processes Engineering studies, in the 2012-2013 period.

The procedure proposed in this paper is described below:

Stage I: Research diagnostic.

Phase I: Determination of topics for research diagnosis. Research diagnostic must start with a general characterization of the municipality, including topics like, geographic location, area extension, population density, urban and rural settlements, production and service entities, main economic and social activities, characterization of the Municipal University (CUM), quantity and viability of projects for local development, and the main unsolved issues.

Phase II: Research classification according to themes, companies and organizations in the location. This phase classifies and arranges existing research by topics and areas of knowledge, also identifying companies and organizations that can benefit from research.

Phase III: Application (surveys to leaders from the municipal government, and executives and staff from organizations researched. In order to know the criteria about the outcome of local research, come type of method should be applied to municipal government leaders, executives and staff from the researched organizations. The methods applied to municipal government leaders are intended to determine criteria and effect of government actions on local research.

As for executives and staff of organizations, the purpose is mainly directed to the level of application and introduction of results..

Stage II: Impact measurement.

Phase I: Detailed description of scientific results. A detailed description of research in terms of the topics dealt with includes items like, target workplace, target organization, theme studied, practical contribution, main results and impacts achieved, and application viability. Also includes is information about the current worker bond to the company.

Phase II: Variables and indicators of impact measurement.

Variable 1: research association to the local environment. Phase II: Research classification according to themes, companies and organizations in the location.

Indicator

- Correspondence between the problem studied and the stock of municipal problems.
- Contextualization of research within the target company.
- Planning within the company´s working system, implementation of the results achieved.
- Executive control system of result implementation.

Variable 2: Knowledge and innovation of research result application in the location.

Indicator

- Research aimed at solving municipal strategic problems.
- Number of results derived from local generalized research.
- Per cent of research that contribute to local development projects.
- Per cent of research results visible at different sites.

Variable 3: Impact of research management in the municipality.

Indicator

- Satisfaction of the party, municipal government, and the company staff with the outcome of research.
- Follow up and feedback of research results applied for local development.
- Per cent of production and service organizations that apply the results of research.
- Per cent of results generalized regarding the total volume of research done.
- Results with clear contribution to solve problems in the municipality.

Phase III: Measurement criteria of indicators. The measurement criteria for indicators depend on a series of conditions that move from "optimum" to "awful". Maximum scale evaluation (Very satisfactory" 5 (MS), is achieved only if all optimum or ideal conditions of the indicator are fulfilled. Qualifications of

"Satisfactory" 4 (S), "Acceptable" 3 (A), and "Deficient" 2 (D) will be given if at least one of the conditions in the upper scale fails. This scale will be used to assess impact and have a feedback of research done in a particular period, implementation and effects of application in the municipality.

Stage III: Result assessment.

Phase I: General assessment and evaluation of results. Assessment of variables and indicators suggested for all research must be made. The main results must be summarized, considering the quantitative and qualitative criteria about each research impacts on the location.

Generally, the results achieved with the new procedure must show the impact of research management in the municipality. Accordingly, the local authorities will be able to assess deficiencies, plan and control the application of the results from research to favor local development. Follow up actions must be taken, including feedback from research results, observed in the area of knowledge, the economy, and society, to provide solutions to the local problems.

RESULTS AND DISCUSSION

Application of procedure to assess the impact of scientific research in the municipality of Rodas, made to the Agro industrial Processes Engineering Degree (2012-2013), at the University of Cienfuegos.

Characterization of the municipality of Rodas.

Rodas is located to the northwest of the city of Cienfuegos, Cuba. It borders on Matanzas and Villa Clara provinces to the north; on Cienfuegos municipality to the south; on Aguada and Abreus municipalities to the west; and on Lajas and Palmira municipalities to the east. It covers 551.52 km2, the fourth largest municipality in the province.

Currently, the municipality has 31 settlements, 7 urban and 24 rural areas (11.5% of the province total). The economy includes 14 organizations from the local delegations of provincial administration; 7 subsidized bodies; and 17 organizations of national administration. The main economic activity is sugar cane agriculture (78% of cultivated areas); sugar is the top export product.

The location also embraces the Livestock Company (Empresa Pecuaria), with a large production; three poultry farms, two for layers and the other for breeding; an asphalt plant; and quite a few service centers for recreation, education, health, etc.

The university opened in 2002, with Humanity Studies. In the academic year 2003-2004, Industrial Engineering, Agricultural Engineering, and Accounting were added. In 2005-2006 Agro industrial Process Engineering and Agronomy Engineering were incorporated.

The Industrial Process Engineering was mainly populated with students from the Alvaro Reynoso Assignment (TAR). Initially, it had 22 students, and 19 of them graduated in 2012-2013. Research was done in 15 municipal organizations (Table 1).

(Table 1) Research done in companies and organizations of Rodas

Companies			
14 de Julio Cane sugar company	5 de Septiembre Cane sugar company	Ciudad Caracas Cane sugar company	Ministry of Agriculture
Design of working competence matrixes in the area of sugar production at 14 de Julio UEB.	Procedure to enhance efficiency of the agro industrial process at 5 de Septiembre UEB.	Analysis of the purification process to achieve improved sugar quality at the Ciudad Caracas UEB.	Strategic projection to improve agro industrial yields at Carolina UEB.
Sugar cane agroecological management program to increase sales at 14 de Julio UEB.			
Study of the crystallization process quality at 14 de Julio UEB.			
Sustainability of agro industrial production with sustainable land management indicators to achieve better agro industrial results at San Lino UEB.	Assessment of irrigation quality effect at Dos Hermanos UBPC Cooperative.		Development strategy of La Vega State-Owned Unit UEB.
Sustainability of agro industrial production with land sustainable management indicators to achieve better agro industrial results at Laos Cooperative UBPC.	Sustainability of agro industrial production with land management indicators to achieve better agro industrial results at 26 de Julio Cooperative CPA.		Strategic projection to enhance agro industrial yields at Julio Antonio Mella Cooperative CCSF.
Sustainability of agro industrial production with land management indicators to achieve better agro industrial results at El Limpio Cooperative UBPC.	Sustainability of agro industrial production using land management indicators to achieve better agro industrial results at Salvador Herrera Cooperative CPA.		Strategic projection to improve agro industrial yields at Cándido Cuesta Cooperative CCSF.
Assessment of irrigation quality effect at EL Limpio Cooperative UBPC.			
Sustainability of agro industrial production with land management			

indicators to achieve better agro industrial results at La Esperanza Cooperative UBPC.

Sustainability of agro industrial production using land management indicators to achieve better agro industrial results at Nicaragua Libre Cooperative CPA.

Assessment of irrigation quality effect at Nicaragua Libre Cooperative.

Total Organizations: 15 Research Number: 19

Research topics were grouped according to the main themes worked in the location, to assess the impact of research done at the university, using the suggested procedure. Research has been directed to address issues regarding sustainable land management, irrigation quality, process analysis and strategic projection of various agro industrial organizations. Themes: Strategic projection (5), Land sustainable management (8), Industrial process analysis (3), Irrigation quality (3).

(Table 2) Themes, research and results of research done in Rodas

Themes	Research	Main results
Strategic projection.	5 5	-Design of working competence matrixes in the area of sugar production. Development strategy for La Vega State-Owned Unit. - Strategic projection to enhance agro industrial yields in two Strengthened Cooperatives (CCSF) and one Basic Unit of Sugar Cane Production (UBPC).
Land sustainable management.	8	-Sustainability of agro industrial production with land management indicators to achieve better agro industrial results in 3 UBPC, 3 CPA, and 1 UEB. at 26 de Julio Cooperative. - Sugar cane agroecological management program to increase sales at UEB "Atención al Productor". 14 de Julio.
Analysis of Industrial processes.	3 3	Study of the crystallization process quality at 14 de Julio UEB . Procedure to enhance efficiency of the agro industrial process at 5 de Septiembre. Analysis of the purification process to achieve improved sugar quality at the Ciudad Caracas.
Irrigation quality.	3 3	- Assessment of irrigation quality effect on industrial yields in two UBPC and 1 CPA. at EL Limpio Cooperative. Assessment of irrigation quality effect at EL Limpio Cooperative.

To study the criteria about local research, executives and staff of target organizations were surveyed, in order to identify their knowledge about research done and its application. Below are the main criteria achieved during the application of questionnaires:

- 27% of companies or organizations claim having requested students to the municipal university to conduct research.

- 27% showed satisfaction with the results of research and the solutions proposed to tackle the existing problems.

- 95% said they knew about the research done in their company.

- 100% was unaware of research contextualization to the new reality of companies and the importance they have to accomplish their mission, and achieve development.

- 64% noted that research is being done currently.

- 77% acknowledges the usefulness of research and the economic, social, and practical contributions they have.

Impact measurement. Research tabulation was made to measure impact, including all the variables and indicators.

Variable 1: research association to the current local reality. Phase II: Research classification according to themes, companies and organizations in the location.

Correspondence between the problem studied and the stock of municipal problems.	Very satisfactory: 100%
Contextualization of research within the target company.	Very satisfactory: 10.5% Satisfactory: 63% Acceptable: 26.5%
Planning within the company´s working system, implementation of the results achieved.	Satisfactory: 5% Acceptable: 63% Deficient: 32%
Executive control system of result implementation.	Satisfactory: 5% Acceptable: 63% Deficient: 32%

Variable 2: Knowledge and innovation of research result application in the location.

Research done to address priority issues in the municipality.	Satisfactory: 100%
Number of results derived from local generalized research.	Satisfactory: 5% Acceptable: 63% Deficient: 32%
Per cent of research that contribute to local development projects.	Satisfactory: 100%
Per cent of research results visible at different sites.	Deficient: 100%
Variable 3: Impact of research management in the municipality.	
Satisfaction of the party, the government, and the company personnel with the outcome of research.	Satisfactory: 100%

Follow up and feedback of research results applied for local development.	Satisfactory: 5% Acceptable: 63% Deficient: 32%
Per cent of organizations that implement the results of research done.	Satisfactory: 5% Acceptable: 63% Deficient: 32%
Per cent of results generalized regarding the total volume of research done.	Satisfactory: 5% Acceptable: 63% Deficient: 32%
Results with clear contribution to solve problems in the municipality.	Satisfactory: 100%

Below are the results and behavior of variables and indicators, based on the criteria for the procedure.

Variable 1: research association to the local environment. Phase II: Research classification according to themes, companies and organizations in the location.

Themes	Correspondence between the problem studied and the stock of municipal problems.	Contextualization of research within the target company.	Planning within the company´s working system, implementation of the results achieved.	Executive control system of result implementation.
Strategic projection.	Very satisfactory: 100%	Very satisfactory: 20% Satisfactory: 40% Acceptable: 40%	Satisfactory: 20% Acceptable: 40% Deficient: 40%	Satisfactory: 20% Acceptable: 40% Deficient: 40%
Land sustainable management.	Very satisfactory: 100%	Very satisfactory: 12.5% Satisfactory: 62.5% Acceptable: 25%	Acceptable: 87.5% Deficient: 12.5%	Acceptable: 87.5% Deficient: 12.5%
Process analysis	Very satisfactory: 100%	Satisfactory: 67% Acceptable: 33%	Acceptable: 100%	Acceptable: 100%
Irrigation quality.	Very satisfactory: 100%	Satisfactory: 100%	Deficient: 100% Deficient: 40%	Deficient: 100% Deficient: 40%
Summary	Very satisfactory: 100%	Very satisfactory: 10.5% Satisfactory: 63% Acceptable: 26.5%	Satisfactory: 5% Acceptable: 63% Deficient: 32%	Satisfactory: 5% Acceptable: 63% Deficient: 32%

Variable 2: Knowledge and innovation of research result application in the location.

Themes	Research done to address priority issues in the municipality.	Number of results derived from local generalized research.	Per cent of research that contribute to local development projects.	Per cent of research results visible at different sites.
Strategic projection.	Satisfactory: 100%	Satisfactory: 20% Acceptable: 40% Deficient: 40%	Satisfactory 100 %	Deficient: 100% Deficient: 40%
Land sustainable management.	Satisfactory: 100%	Acceptable: 87.5% Deficient: 12.5%	Satisfactory: 100%	Deficient: 100% Deficient: 40%

Process analysis	Satisfactory: 100%	Acceptable: 100	Satisfactory: 100%	Deficient: 100% Deficient: 40%
Irrigation quality.	Satisfactory: 100%	Deficient: 32%	Satisfactory: 100%	Deficient: 100% Deficient: 40%
Summary	Satisfactory: 100%	Satisfactory: 5% Acceptable: 63% Deficient: 32%	Satisfactory: 100%	Deficient: 100% Deficient: 40%

Variable 3: Impact of research management in the municipality.

Themes	Satisfaction of the party, the government, and the company personnel with the outcome of research.	Follow up and feedback of research results applied for local development.	Per cent of organizations that implement the results of research done.	Per cent of results generalized regarding the total volume of research done.	Results with clear contribution to solve problems in the municipality.
Strategic projection.	Satisfactory: 100%	Satisfactory: 20% Acceptable: 40% Deficient: 40%	Satisfactory: 20% Acceptable: 40% Deficient: 40%	Satisfactory: 20% Acceptable: 40% Deficient: 40%	Satisfactory: 100%
Land sustainable management.	Satisfactory: 100%	Acceptable: 87.5% Deficient: 12.5% Deficient: 40%	Acceptable: 87.5% Deficient: 12.5% Deficient: 40%	Acceptable: 87.5% Deficient: 12.5% Deficient: 40%	Satisfactory: 100%
Process analysis Irrigation quality.	Satisfactory: 100%	Acceptable: 100% Deficient: 100% Deficient: 40%	Acceptable: 100% Deficient: 100% Deficient: 40%	Acceptable: 100% Deficient: 100% Deficient: 40%	Satisfactory: 100% Satisfactory: 100%
Summary	Satisfactory: 100%	Satisfactory: 5% Acceptable: 63% Deficient: 32%	Satisfactory: 5% Acceptable: 63% Deficient: 32%	Satisfactory: 5% Acceptable: 63% Deficient: 32%	Satisfactory: 100%

General impact assessment

The assessment of indicators in variable association with research and topics to solve problems, and the current reality of the municipality, is acceptable. However, predomination of very satisfactory and satisfactory criteria about local scientific research problems and their contextualization in target organizations, is significant.

It was observed that 27% of research done are excluded from implementation in the system of planning and executive controls. It shows technical and

organizational deficiencies, since generalization is not always written in the target company´s framework documents for further implementation, thus affecting continuity of research and definitive solution to deficiencies.

Concerning the results implementation indicator, it was observed that planning and introduction of results were not accomplished in irrigation quality. Besides, strategic projection 40% of results are not being applied. Although 68% of research results are applied, 32% of static results are found in the previously mentioned areas.

Analysis of indicators within the variable related with knowledge and innovation, during local application of research showed that Academic research had a positive effect on knowledge management and innovation in Rodas; 100% of research topics pursued local strategic priorities.

Likewise, 100% of research contributes to local development projects and responds to the existing municipal needs. It contributes to development strategies through diagnostics and research, based on the results achieved, and it guarantees meeting the demanding challenges of local economic development.

However, the diagnostic showed that not a single research topic is visible at available sites. The results are, therefore, excluded to a greater number of users, and generalization falls short. It was the only deficient indicator within the variable.

The impact of research management in Rodas based on the variable indicators may be assessed as satisfactory. Generally, high satisfaction was observed in the party authorities and the municipal government, and in the company staff, with the outcome of research. The satisfaction degree was mainly given by the number of problems solved, the contributions made, the results achieved, pertinence and relevance of research, contribution to the new economic model, generalization capacity, and their response to the local target company needs.

Follow up and feedback were acceptable, in terms of locally-based research to foster local development. In variable 1, however, implementation and generalization planning and control are deficient, according to the organizational management system, and their executives.

Although 68% is satisfactory for target organization application of the results of research done in the Agro industrial Process Engineering Studies (13 out of 19), and there is a contribution to finding solutions to local demands, deficiencies were observed in generalizing of irrigation quality and strategic projection results (26% of all research).

Companies must work on the whole of actions planned to meet that goal; efforts must also be made on continuity of execution and the systemic character to carry out follow up and feedback of research results.

CONCLUSIONS

Impact assessment today, with the growing number of local research topics, is a necessity to measure outcomes (qualitatively and quantitatively), and compare the desired degree of execution.

The application of this procedure, through stages, variables and indicators made possible to have acceptable association of research with the current reality observed locally. Satisfactory was granted to knowledge and innovation of research result implementation, and research management impact in the municipality, with a significant social and economic contribution in the location.

RECOMMENDATIONS

This procedure may be used in other University Degree studies.

Further research must go deeper into impact classification.

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