DOI: 10.13140/RG.2.2.32779.49447
http://dx.doi.org/10.13140/RG.2.2.32779.49447
Cultivos Tropicales, 2015, vol. 36, no. 3, pp. 14-19 july-september

ISSN print: 0258-5936
ISSN online: 1819-4087

Ministerio de Educación Superior. Cuba
Instituto Nacional de Ciencias Agrícolas
http://ediciones.inca.edu.cu

THE CULTIVATION OF CORN (*Zea mays* L.) INSIDE OF THE AGRARIAN SECTOR OF HUAMBO-ANGOLA. PART II. DOMAINS OF RECOMMENDATIONS AMONG THOSE PRODUCING OF LOW INPUTS

El cultivo de maíz (*Zea mays* L.) dentro del sector agrario de Huambo-Angola. Parte II. Dominios de recomendaciones entre los productores de bajos insumos

Dácia Julieta C. J. Vaz Pereira[1]✉ and Ángel Leyva Galán[2]

ABSTRACT. Considering that 97 % of the productive agroecosistemas of the country of Huambo of Central Planalto of Angola is exploited for producing of low revenues, it was determined through the Statistical Pattern of Mensuration of Impact (MEMI) the impacts of the quantitative variables, with four main (CP) components to value the change that they experienced the different properties inside oneself level of agrarian (NDAI) development. Marked differences took place according to results of Dendrograma with the composition of five groups, influenced fundamentally by four Main (CP) Components that explained 73 % of the total variability corresponding 28 % to children in school age that they attend classes, 21 % to the productivity for surface, 13 % to the justness of the family composition and 11 % to the age of the proprietors. The evaluation showed that a third of the 150 properties presented positive impacts to the attention of the education of the children, 15 % turned out to be that of productive better results and 85 % only takes place for the subsistence if I support for sale. It could identify the qualitative variables that can to contribute for improve to the productive long term systems. For everything it, will be possible to act with appropriate recommendations to each group to induce the change toward a bigger approach to the sustainability of the agricultural ecosystem of the municipality of Huambo.

Key words: sustainability, agroecosistemas, impact

RESUMEN. Considerando que el 97 % de los agroecosistemas productivos del Planalto Central de Huambo, Angola, son explotados por productores de bajos ingresos, se determinó a través del Modelo Estadístico de Medición de Impacto (MEMI) el comportamiento de las variables cuantitativas, con cuatro Componentes Principales (CP) para valorar el cambio que experimentaron las diferentes fincas dentro de un mismo nivel de desarrollo agrario (NDAI). Se produjeron diferencias marcadas según resultados del dendrograma con la composición de cinco grupos, influidos fundamentalmente por cuatro componentes principales (CP), que explicaron el 73 % de la variabilidad total, correspondiendo el 28 % a niños en edad escolar que asisten a clases, el 21 % a la productividad por superficie, el 13 % a la equidad de la composición familiar y el 11 % a la edad de los propietarios. La evaluación mostró que un tercio de las 150 fincas presentaron impactos positivos a la atención de la escolaridad de los niños, el 15 % resultó ser el de mejores resultados productivos y el 85 % sólo produce para la subsistencia sin respaldo para la venta. Se pudo identificar las variables cualitativas que pueden contribuir para mejorar a los sistemas productivos a largo plazo. Por todo ello, será posible actuar con recomendaciones apropiadas a cada grupo para inducir el cambio hacia un mayor acercamiento a la sostenibilidad de los agroecosistemas del municipio Huambo.

Palabras clave: sostenibilidad, agroecosistemas, impactos

INTRODUCTION

Angola has an estimated 24 million inhabitants[A] remain poor about 12,5 million living with only 1,7 dollar per day, in a situation of reduced basic services

[1]Instituto de Investigación Agronómica. Angola CP 2104. Docente del Instituto Superior Politécnico de Huambo, Universidad "José Eduardo dos Santos" (UJES).

[2] Instituto Nacional de Ciencias Agrícolas (INCA), gaveta postal 1, San José de las Lajas, Mayabeque, Cuba, CP 32 700.

✉ dacia.pereira@yahoo.com

[A] *Relatoría del Instituto Nacional de Estadística (INE), Angola*, 2014.

and low social indicators population. Most people live in cities (65 %), with its estimated 57 % poverty, while in the field 94 % is reached.

Vulnerable families depend on the land activity for their survival[B]; although cassava seems to have a higher weight in the consumption of foodstuffs in Angola, there is no doubt about the importance of corn in grain[C], whose production predominates in the Planalto Central[D], with yields ranging between 250 and 700 kg ha^{-1}. Low-input farmers are responsible for 90 to 95 % of production (1).

With the annual increase in the rate of population growth and low yields of major crops, the government of Huambo (Angola) declared 2014 as the year of agriculture, with increased investment in growing maize to ensure productivity and reduce food dependency. It is therefore necessary to strengthen production and productivity of small farmers, improve food security and nutrition and strengthen the sustainable management of natural resources[B]. Natural, human, capital and producción: In this context the principles of sustainable agriculture based on making right decisions about resources of agricultural systems: natural, capital and production[E] are applicable.

MATERIALS AND METHODS

From diagnosis made in 150 families, through a simple random sampling, all data for further processing will be tabulated. For the cluster analysis, a hierarchical method was used. The distance used was the squared Euclidian[F] (2, 3).

For quantitative variables the Statistical Model Impact Measurement (MEMI) is applied according to previous studies (4, 5), Principal Components were selected and descriptive statistics were determined, Pearson correlations, selection of components with eigenvalue, greater than or equal to the unit (λ≥1), as established the method[G] (3), and the agglomeration method was to link inter-group (2, 6, 7, 8). The cut induced the fusion process detention of different groups was performed at a distance of 7,5 % (rescaled value) according to the Ward agglomeration method and measurement interval square Euclidian distance

For impact analysis they took into account the factor scores of the results obtained from the four main components. The plot was to assess the change experienced by the different farms within the same level of development (NDAI).

As part of the characterization for qualitative variables, frequency tables were used through the Docimo chi-square and the results were statistically compared.

RESULTS

Specific diagnosis. Producers of low income (NDAI1)

Considering that among small producers (NDAI), representing 97 % of the players in the municipality, there may be marked differences based on the view that there are no equal agrarian systems, nor are there two farmers whose circumstances are identical (9). In addition, the innovative capacity of some actors can raise their living standards over the majority, there being a 25 % of them, capable of transforming the environment favorably when they receive updated information[H]. It would be a mistake to peasant systems as a homogeneous group to which it can propose uniform "technological packages". In this regard, it should seek and devise appropriate solutions to conditions of each of producer categories (10).

In Table I, the quantitative variables evaluated, considered by the author as basic for the future development of rural communities are presented. The variable age of farm owners displayed a relative strength, to reflect a mixture of rising young owners, with the experience of older workers. Family with 50 % of children is strengthened, unfortunately only 60 % of school age attends school.

[B] FAO. *Angola anuncia su contribución al fondo africano para la seguridad alimentaria* [en línea], 2013, [Consultado: 27 de agosto de 2015], Disponible en: <http://www.fao.org/news/story/es/item/169177/icode/>, [Noticias].

[C] Programa Alimentar Mundial. *Segurança Alimentar e modos de Vida no Planalto Central de Angola*, 2005, [Com financiamento da GTZ e da Parceria com o DFID para o Reforço Institucional do PAM].

[D] Instituto de Investigaçao Agronómica. *Plano para o quinquénio 2004-2009. Programa de investigação de cereais*, edit. Departamento de Botânica e de Melhoramento de Plantas, 2003, [XVI Conselho Científico Alargado do Instituto de Investigação Agronómica, Luanda].

[E] Morales, A.D. y Betancort, J. *Identificación de la flora arvense en cereales de invierno en Tenerife y medidas de control Información técnica* [en línea], 2012, [Consultado: 5 de noviembre de 2014], Disponible en: <http://www.agrocabildo.org/publicaciones_detalle.asp?id=442>.

[F] La O, M. *Estudio de conservación de la cabra criolla cubana en la sub-cuenca del Valle del Cauto* [Doctorado], Instituto de Ciencia Animal, San José de las Lajas, Mayabeque, 2013.

[G] Varela, M.N. *Los Métodos biplot como herramientas de análisis de interacción de orden superior en un modelo lineal-bilineal* [Tesis de Doctorado], Universidad de Salamanca, España, 2002.

[H] Leyva, A. ‘‘Metodología para evaluación de agroecosistemas Integrales’’, *Encuentro provincial de la asociación de técnicos agrónomos y forestales (ACTAF) de la Habana*, Instituto Nacional de Ciencias Agrícolas, 2014.

Table I. Description of quantitative variables evaluated and matrix rotated components

Indicators	Mean	SD*	Components			
			1	2	3	4
Age of the farm owner	44,9	11,3	0,24	0,07	0,00	0,74
Number of people live in the house	5,6	1,0	0,03	0,08	0,91	0,13
Number of children	3,1	1,1	0,47	0,00	0,69	-0,07
Number of children with school age	2,3	0,6	0,94	0,01	0,16	0,03
Number of children attend to school	2,3	0,6	0,94	0,00	0,13	0,02
People who know reading and writing	1,1	0,3	0,31	0,10	-0,12	-0,59
Number of rooms per house	4,9	1,0	0,32	0,13	-0,27	0,30
Yield per ha^{-1}	199,4	207,5	0,00	0,97	0,02	0,02
Quantity of sold production (kg)	44,1	132,0	0,04	0,97	0,03	0,01
Eigenvalue			2,53	1,89	1,19	1,00
Explained variance %			28,07	20,97	13,24	11,14
Accumulated variance %			28,07	49,04	62,28	73,42

*SD – Standard deviation

With the measure of Educational Reform process underway in Angola, which is in accordance with the Basic Law of the Education System, Law no. 13/01 of December 31rst, 2001, equity, quality and education throughout life, in the National Action Plan of Education for alll is guaranteed[I].

Yields per hectare are low end (400 kg ha^{-1}) despite being corn a major economic screed of the diet in this region and of which 22 % is marketed[J]. Some authors claim that two tons per hectare are considered low yield (11); Additional studies in similar agro-ecological conditions, reported superior results[K]

Main Components Analysis

The selection of four main components (MC), which account for 73 % of the total variability, using the criterion of eigenvalue greater than or equal to the unit value, reflecting the importance of school-age children and their attendance (MCI) with variance accounted for 28 %; while the production obtained per hectare and the amount of production that manage to sell (MCII) accounted for 21 %; the total number of the family and of them children (MCIII) contributed 13 %, while the age of the owners (MCIV) 11 %.

The graphical representation that is presented in Figures 1, 2, 3 and 4 allows valuing differences among farms within the same level of agrarian development[F] (12).

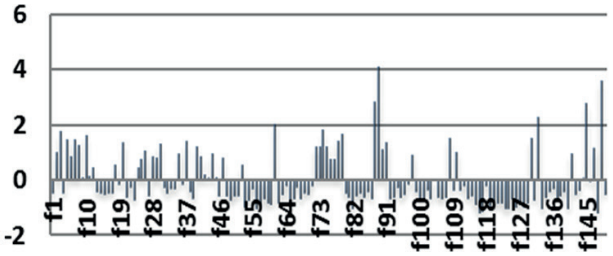

Figure 1. (MCI) Impact of education with school-age component

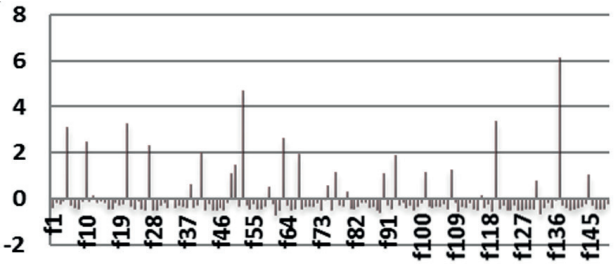

Figure 2. (MCII) Impact measurement maize production versus quantity of product sold

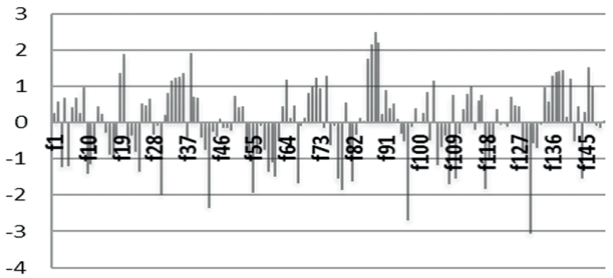

Figure 3. Impact measurement of inhabitants in the farm and number of children. (MCIII)

[I] Pinda, S.A. "Actual situação da educação em Angola", *Conferência do Centro de Estudos Africanos do ISCTE*, 2005.

[J] Ministério da Administração do Território*Províncias e Municípios* [en línea], [Consultado: 27 de agosto de 2015], Disponible en: <http://www.mat.gov.ao/destaques-topo/provincias-e-municipios>.

[K] Centro de Estudios de Investigación Científica. Universidad Católica de Angola*Relatórios* [en línea], [Consultado: 27 de agosto de 2015], Disponible en: <http://www.ceic-ucan.org/?page_id=167>.

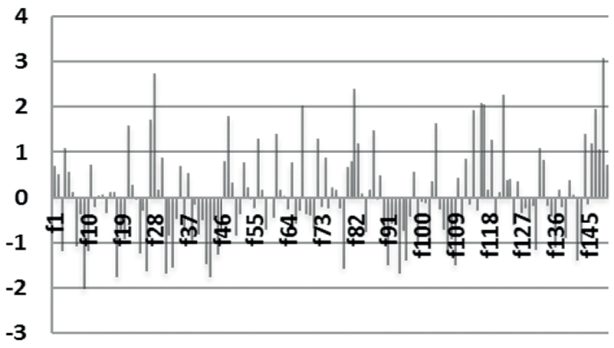

Figure 4. Impact measurement component: age of the farm owner (MCIV)

The impacts of children education component are appreciated, taking into account the number of children in school age and attending school.

A third of the 150 farms have positive impacts, highlighting the farms 89 and 149, where the total number of school age children attends school. However, other farms (one hundred), whose children do not attend school, spend most of their time to support agricultural activities of the farm, which it is a current family support and a brake to the development and future.

In this sense, it suggests that education plays a very important role in the adoption and diffusion of agricultural innovations, producing relevant results and those farmers and their descendants require ongoing training to face the new technological challenges imposed by the global development (13).

85 % of farms produce only for subsistence without supporting for sale; on the other hand, due to lack of inputs for the exploitation of cultivation large areas and application of new agricultural technologies and, secondly, the lack of incentive for low prices agricultural[L] products.

Figure 3 shows the impact of the farm leader age component, showing positively to the 50 % of farms whose leaders have aged less than 40 years, which implies that, in a way, the experience of farming practices can contribute to the conservation of agro-ecosystems and, in turn, it is transmitted to new generations, to ensure good soil and the environment. Of the 150 farms, 45 % of them have positive impact on the total number of inhabitants or people that make each family on the farm component (Figure 4), where children represent the largest number (Figure 1); this very important aspect, as more than 65 % of the population are children and they are the future of the Angolan nation[M], considering that the fertility rate is 6,05 children per woman, one of the largest in the world, which is causing significant population increase.

Application of hierarchical cluster shaping groups for domains recommendations

The high degree of heterogeneity among farms that make up a population hinders decision-making (14), so, this went to the application of the technique that allowed the conception of a corresponding analysis dendrogram and shaping five groups of producers units (Figure 5).

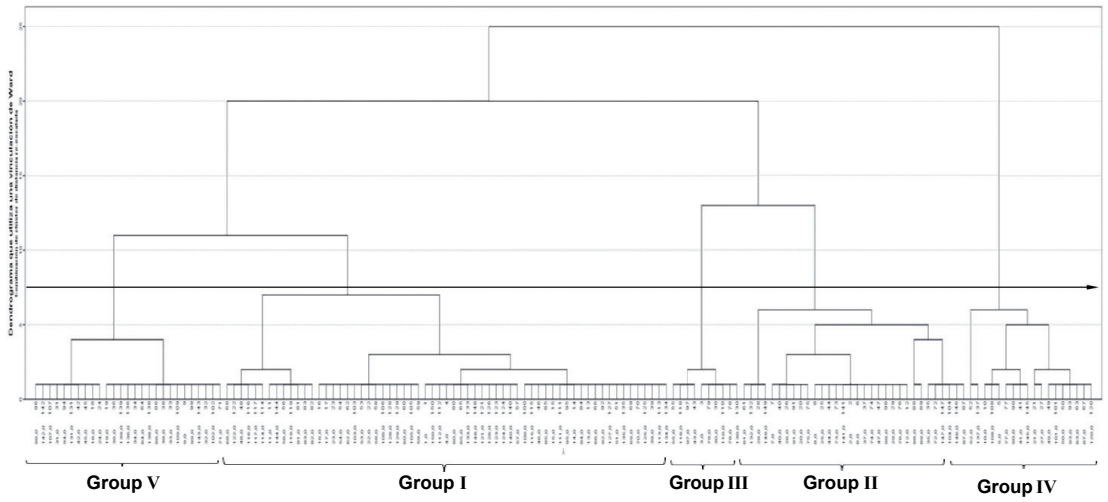

Figure 5. Dendrogram specifying the groups formed within the same level of agricultural development (NDAI)

[L] De Schutter, O. *Informe del Relator Especial sobre el derecho a la alimentación* [en línea], [GE.10-17852], Consejo de Derechos Humanos 16º período de sesiones, 2010, [Consultado: 17 de septiembre de 2014], Disponible en: <http://www.ohchr.org/Documents/HRBodies/HRCouncil/RegularSession/Session19/A-HRC-19-59_sp.pdf>.

[M] Vaz- Pereira, D. *Participacao da mulher no processo de producao agricola vinculado ao microcredito nas comunidades rurais da provincia do Huambo, Angola* [Tese de Engenharia], Universidade Agostinho Neto, Faculdade de Ciencias Agrarias do Huambo Angola, Huambo, Angola, 2007, p. 33.

The dendrogram (Figure 5) with Table II, which defines the groups, allow distribution analysis, from the perspective of sustainability, taking into account the main characteristics of the farms.

Sustainability principles in organic farming are based on the high plant and diversity animal, integrated production systems where intercropping and rotations play a decisive role, practice soil conservation, biological control of pests and diseases, balance environmental conservation and the creation of agro-ecosystems with high resilience (15).

Based on these principles, the resulting dendrogram five groups are still far from those goals.

Although the group IV, followed by Groups II and V, presented numerical values above other performance and with animal and plant diversity than the rest, it is not attributed closeness to sustainability, as their productions are based on high-input agriculture.

It could be considered the group I, followed by group III, close to the axis that traces the way towards agroecological sustainability make very limited use of chemical inputs; however ridiculously low crop yields, coupled with the absence of other determining indicators such as the lack of conservation awareness and knowledge are limitations to this designation. For all that it is imperative to train producers to be able to conduct their agroecological farms under precepts, which articulate the necessary link to sustainability.

Among the qualitative variables, gender equality highlights, this deserves special attention by the social role played by Angolan women in rural everyday life. For the conditions of Huambo, 40,7 % of women are community leaders, who lead and make decisions on their farms to support their families. In relation to the aid they receive from family group in leading the agroecosystem, it was found that 70 % receive such aid; however, many of them involving children of school age, which is a weakness of this indicator.

57 % of families develop the scoop of the trilogy soil-plant-animal, which is a principle of sustainability[N]; however, meat and its derivatives are not part of the daily diet, the main destination marketing to ensure income. The lack of resources for holding makes most of the producers (82,7 %) grow only 50 % of its properties, specifically dedicating corn production (80 %).

CONCLUSIONS

- The absence of conservation techniques such as the use of polyculture, animal traction, use of local varieties, animal manure and cultural efficient precedents, has facilitated the marked degradation of soils, added to the overuse of chemicals, whether to control pests, weeds or to yield increase[O] (16, 17).
- It corresponds to sustainable development facilitators of based on agroecology, encourage lower-income producers to manage wisely the resources they receive, combining ancient techniques with modern, thereby increasing environmental care[B].
- A conclusive assessment of the indicators evaluated in the Agricultural sector in the province of Huambo, Angola, suggested to make the following observation: qualitative indicators with quantitative ones reflect the current state of estrangement to agricultural sustainability in maize production from the agroecological vision.

[N] Altieri, M.A. *Agroecología, bases científicas para una agricultura sustentable*, edit. Nordan, 1999.

[O] Altieri, M.A. y Nicholls, C. *Diseños agroecológicos para incrementar la biodiversidad de entomofauna benéfica en agroecosistemas*, 1.ª ed., edit. Sociedad Científica Latinoamericana de Agroecología (SOCLA), Medellín, Colombia, 2010, p. 100.

Table II. Classification of the groups according to quantitative indicators

Groups	G-I		G-II		G-III		G-IV		G-V	
Number of farms	63		32		10		18		27	
	average	DT	average	DT	average	DT	average	DT	average	DT
Age of the owners	40,746	9,3446	52,063	12,5053	37,100	7,6077	44,889	7,9623	49,259	11,1583
People who live in the house	5,873	0,8326	6,031	1,1496	5,200	1,0328	5,778	0,8085	4,630	0,7415
Children	2,952	1,0384	4,000	1,1072	3,300	1,0593	3,167	0,9852	2,333	0 ,4804
Children in school age	2,000	0,0000	3,094	0,6891	2,600	0,5164	2,500	0,6183	2,000	0,0000
Children attend school	2,000	0,0000	3,094	0,6891	2,600	0,5164	2,500	0,6183	2,074	0,2669
Children know how to read and write	1,032	0,1767	1,094	0,2961	1,900	0,3162	1,222	0,4278	1,074	0,2669
Rooms in the house	4,476	1,0755	5,250	0,9837	4,600	0,8433	5,222	0,8085	5,444	0,8006
Yield per ha^{-1}	139,603	72,9079	135,625	50,6848	98,500	2,4152	661,667	278,8263	143,519	106,7241
Quantity sold kg	0,000	0,0000	4,688	26,5165	0,000	0,0000	348,333	197,0145	7,407	26,6880

- It is necessary to update the actors and participatory actions and decision-makers with technical and scientific information with agroecological court to raise maize production in Huambo, Angola.

BIBLIOGRAPHY

1. Nuñgulu, A. y Lima, A. ''Brocas do milho no Planalto Central de Angola. Gestão das suas populações com recurso a plantas-isco e a plantas repelentes'', ed. Moreira, I., *Angola. Agricultura, Recursos Naturais e Desenvolvimento Rural*, edit. ISA Press, Lisboa, 2006, pp. 125-140.
2. Carmona Sierra, A. y Nahuelhual Muñoz, L. ''Tipificación y caracterización de sistemas prediales: caso de estudio en ancud, isla de chiloé'', *Agro Sur*, vol. 37, no. 3, 1973, pp. 189-199, ISSN 03048802, DOI 10.4206/agrosur.2009.v37n3-03.
3. Hair, J.F. y Suárez, M.G. *Análisis multivariante* [en línea], vol. 491, edit. Prentice Hall Madrid, 1999, [Consultado: 27 de agosto de 2015], Disponible en: <http://www.sidalc.net/cgi-bin/wxis.exe/?IsisScript=AGRISUM.st&formato=2&cantidad=1&expresion=mfn=000231>.
4. Torres, V.; Martínez, O.; Noda, A.; Medina, Y. y Rodríguez, Y. ''Evaluation of the statistical suppositions in the statistical model of impact measuring (MEMI), in a case study'', *II Workshop of Computer Science and Applied Biostatistics to the Agricultural Sciences, III Congress of Animal Production*, La Habana, Cuba, 2010.
5. Torres, V.; Cobo, R.; Sanchez, L. y Raez, N. ''Statistical tool for measuring the impact of milk production on the local development of a province in Cuba'', *Livestock Research for Rural Development*, vol. 25, no. 9, 2013, ISSN 0121-3784, [Consultado: 27 de agosto de 2015], Disponible en: <http://www.lrrd.cipav.org.co/lrrd25/9/torr25159.htm>.
6. Miranda, I. ''Coeficientes de similaridad para variables mixtas. Nueva Propuesta'', *Revista de Protección Vegetal*, vol. 13, no. 2, 1998, pp. 127-131, ISSN 1010-2752.
7. Valbuena, D.; Verburg, P.H. y Bregt, A.K. ''A method to define a typology for agent-based analysis in regional land-use research'', *Agriculture, Ecosystems & Environment*, vol. 128, no. 1–2, octubre de 2008, pp. 27-36, ISSN 0167-8809, DOI 10.1016/j.agee.2008.04.015.
8. Hair, J.; Anderson, R.; Tatham, R. y Black, W. *Análisis multivariado de datos*, 1.ª ed., edit. Pearson Prentice Hall, Madrid, España, 2009, p. 768, ISBN 84-8322-539-5.
9. Sarandón, S.J. ''Biodiversidad, agrobiodiversidad y agricultura sustentable. Análisis del Convenio sobre Diversidad Biológica'', en: León Sicard, T.E. y Altieri, M., *Vertientes del pensamiento agroecológico: fundamentos y aplicaciones*, edit. Instituto de Estudios Ambientales, Universidad Nacional de Colombia Sede Bogotá, Sociedad Científica Latinoamericana de Agroecología (SOCLA), Medellín, Colombia, 2010, pp. 105-129, ISBN 978-958-719-572-9.
10. Benítez, D.; Ramírez, A.; Guevara, O.; Pérez, B.; Torres, V.; Díaz, M.; Pérez, D.; Guerra, J.; Miranda, M. y Ricardo, O. ''Factores determinantes en la eficiencia productiva de fincas ganaderas de la zona montañosa de la provincia Granma, Cuba'', *Revista Cubana de Ciencia Agrícola*, vol. 42, no. 3, 2008, pp. 247–253, ISSN 0034-7485, 0864-0408.
11. Coronel, D.M. y Ortuño, P.S.F. ''Tipificación de los sistemas productivos agropecuarios en el área de riego de Santiago del Estero, Argentina'', *Problemas del Desarrollo*, vol. 36, no. 140, 2005, pp. 11-24, ISSN 0301-7036.
12. Kú, V.M.; Pool, L.; Mendoza, J. y Aguirre, E. ''Propuesta metodológica para evaluar proyectos productivos con criterios locales de sustentabilidad en Calakmul, México'', *Avances en Investigación Agropecuaria*, vol. 17, no. 1, 2013, pp. 9-34, ISSN 0188-7890.
13. Martínez-Melo, J.; Torres, V.; Hernández, N. y Jordán, H. ''Utilización del índice de impacto en la caracterización de los factores que influyen en la producción de leche en fincas de la provincia Ciego de Ávila, Cuba'', *Revista Cubana de Ciencia Agrícola*, vol. 47, no. 4, 2013, pp. 367–373, ISSN 0034-7485, ISSN 2079-3472.
14. de Sousa Silva, J. ''La crisis global de la «innovación para el desarrollo». Del positivismo al constructivismo para construir modos de vida localmente sostenibles'', *Revista Cubana de Ciencia Agrícola*, vol. 48, no. 1, 2014, pp. 11–15, ISSN 0034-7485.
15. Altieri, M.A.; Koohafkan, P. y Holt-Giménez, E. ''Agricultura verde: fundamentos agroecológicos para diseñar sistemas agrícolas biodiversos, resilientes y productivos'', *Agroecología*, vol. 7, no. 1, 2012, pp. 7–18, ISSN 1887-1941.
16. Castro, O. de. ''Preparo do solo para a cultura do milho'', *Campinas: Fundação Cargill*, vol. 5, no. 3, 2009, p. 41, ISSN 1679-012X.
17. Castro, O. de. ''Preparo do solo para a cultura do milho'', *Campinas: Fundação Cargill*, vol. 8, no. 3, 2012, p. 41, ISSN 1679-012X.

Received: February 9th, 2015
Accepted: March 10th, 2015

Revista Cultivos Tropicales
Instituto Nacional de Ciencias Agrícolas