Output 5: Strengthened Institutional and Organizational Capacity of R&D Partners in Development and Adaptation of Participatory Research Methodologies

Research Centers...Closer to the Producers

Jorge Luís Cabrera V.[99]

The information technologies facilitate the access to thousands of data, but it is ironic that most of those who work the land to produce food for their own and others' subsistence do not have the possibility to access that information.

The majority of the books specialized in agriculture are not written for the farmers. To facilitate their training, they need books, magazines or communications media that make use of a simple, enjoyable and easy-to-understand language for making their contents available to the producers.

Applying new technologies for communicating and disseminating information

Today the computers and the connection to Internet have become a part of the daily lives of millions of people, providing them rapid access at a very low cost. Thus mechanisms should be sought whereby farmers and technicians can access Internet and other modern communications media. Part of the solution to the difficult situation that the farmers are in is to put the information that they need so badly in their hands.

InforCom Project.

How are we solving this

The Participatory Research with Farmers (IPRA) Project is making an effort to lessen this problem faced by marginal people with little or no access to information. Part of the IPRA Project's strategy is its Web site www.enlacecial.org, which it is expected will respond to the demand, each time higher, for information by the farmers, technicians, local institutions and others, most of whom do not dominate the English language. The users can find documented information about prices of grains, availability of inputs, fertilizers, pesticides and seeds, among others. This Web site places at the disposition of its visitors all the research experiences and validation of technologies developed by the Local Agricultural Research Committees (CIALs) in seven Latin American countries during the last 15 years.

99. Documentation Center – IPRA Project.

The challenge

The world in general is living a true information revolution although for many rural communities the use and access to information technologies and communications media are still a thing of the future. The challenge is to maintain an up-to-date supply of information of interest to technicians, institutions, students and farmers, among other potential publics, interested in methodologies and tools that facilitate their processes and projects.

Results

The IPRA Project Web site is one of the most visited as shown by the statistics for the period December 2004-December 2005:

- Web site in Spanish (http://www.ciat.cgiar.org/ipra/inicio.htm): average monthly visits, 959
- Web site in English (http://www.ciat.cgiar.org/ipra/ing/index.htm): average monthly visits, 720

Documents with greatest number of downloads

Documents, authors and number of times downloaded.

Document	Author	No. of times downloaded
Formulation of criteria for defining pilot areas	Margot Cabrera, FOCAM Project, Bolivia	2333
A dream made reality (case study)	Fanory Cobo, thesis student	1724
The community gets organized to do research	Jacqueline Ashby, Ann Braun, Carlos A. Quirós, Luís A. Hernández, José I. Roa	1561
Quinoa: Recovery of a tradition	José Ignacio Roa	929
CIAL handbooks	IPRA Project	520
Annual report	IPRA Project	215

Other valid options

On the other hand, there are rural communities that do not have electricity or a telephone line, which means that the only source of information may be traditional media including written or oral messages. Nevertheless, it is important to have alternative media that facilitate contacting and interacting with rural communities that are almost isolated.

This valuable work is being done by the technicians and/or CIAL Guides, who visit telecenters or Internet cafés to read or download information of interest, share it and exchange it with the communities with whom they work.

The CIAL link, as well as the technicians and CIAL Guides, constitutes the principal human and virtual strategies in the effort to close the gap that separates the rural communities from the rich and diverse knowledge and information that lie in media or channels such as Internet.

Participatory Evaluation of Technologies for Conserving Forages

José L. García[100] and José I. Roa[101]

Accomplishments

- Producers identified by stakeholder groups for thesis work: Farmers and/or cattle ranchers
- Partial outcomes of preliminary evaluations (open-ended interviews) with producers about the perception of conserving forage in the form of silage and hay.
- Literature reviewed with respect to using the legumes *Vigna unguiculata* (cowpeas) and *Lablab purpureus* (hyacinth beans) in silage- and hay-making processes.
- Preparing, clearing and sowing land with the two legumes (cowpeas and hyacinth beans)
- Doing follow-up in fieldwork, harvesting and obtaining fresh biomass in both materials
- Assessing the producers' preferences for the silage-making technology and materials in the field

Abstract

In the zone of Pescador, Northern Cauca Province (Colombia), there is a shortage of forage available in the dry season due to mismanagement of hillside pastures by the cattle ranchers. The purpose of this research work is to take advantage of the surplus forage material in the rainy season and store it for the dry season. Through participatory methods, the producers are involved in the planning, evaluation and decision-making. The participating farmers were formed into three groups: (1) 6 producers that own cattle, (2) 6 farmers that only grow crops, and (3) 6 producers that are engaged in both activities, referred to as the "combined" group. The partial outcomes of these participatory evaluations of techniques for preparing silage are being analyzed through logistic regression. Thus far all three groups prefer using a cylindrical metal drum as a 'silo' (good to intermediate acceptance) because it gives them more security (made from metal, easy to compact and store forage). The plastic bags had low-to-intermediate acceptance because they retained more air and were not sufficiently compact because the plastic material is too weak. The cowpeas have more uses so they were perceived as being more promising, while hyacinth beans were seen as being good as a cover crop.

Keywords: Participatory evaluation of technologies, silage making, promising legumes, in vitro digestibility

Background

Dual-purpose cattle-raising for small and intermediate producers forms part of the agricultural and livestock system in tropical countries. This system is characterized by a shortage of forage during the year, one of the principal causes being poor management of the grasslands including overgrazing with too high a stocking density, which promotes erosion.

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This damage to the natural resources can be reduced, maintaining a balance between this and technologies employed in improving the biological and economic production of cattle with correct management of the environment in the interaction (soil, animal, plant, producer) (Titterton, 1999); i.e., especially by using forage species (grasses and legumes) that tolerate soil acidity, well-adapted cattle, appropriate stocking density, grasses adapted for cutting and accompanying species (native shrubs). Consequently, during the rainy season the cattle reach their ideal weight; and during the dry season, they lose it again. Forage management and conservation are in the best interest of both the producer and the animal.

There are difficulties in using surplus forages, especially in zones where the supply becomes scarce in dry periods. Taking into account the forage potential that species such as cowpeas (*Vigna unguiculata*) and hyacinth beans (*Lablab purpureus*) have including very good agronomic characteristics such as high protein content, production of biomass, precocity, adaptability to different soils and climates, the producer has some good options available.

Objectives

General objectives

- Determine through methods of participatory evaluation with producers from northern Cauca whether it is feasible to conserve forage (a) in the form of silage[102] and (b) as hay[103]

Specific objectives

- Use a participatory research methodology with groups of farmers, cattle ranchers and a combined group to produce and conserve forage in northern Cauca
- Assess the level of acceptance of the use of hay and silage making by the farmers
- Determine which silage-making technology is better for the producers
- Evaluate nutritional quality with respect to in vitro digestibility of dry matter[104] and crude protein.[105]

Methodology

Conceptualization: A literature review was done including searches in libraries, newspaper collections, degree theses, books, electronic publications, fora and workshops, available at the International Tropical Agriculture Center (CIAT) and the National University of Colombia-Palmira campus, as well as electronic consultations made with zootechnicians and agrostologists (Agudelo 2005).

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102. It is a process for conserving forages based upon anaerobic fermentation (no air) of the biomass so that the original quality of the forage at the time of the cut can be kept for long periods of time.
103. It is the process resulting from dehydrating the forage, which is a feed that contains 15% moisture content, being the most economical source for the animals, except for grazing.
104. Indicates indirectly how much feed will be retained in the gastrointestinal tract for digestion (in the rumen and intestines) and therefore do not appear in the feces.
105. All the compounds that contain nitrogen, urea, amines, amino acids and protein.

Contextualization: This work was done at the CIAT Quilichao Experiment Station located in the municipality of Santander de Quílichao, Cauca Province, Colombia (3°06' N, 76°31' W, at 990 m alt.), with an average temp of 24°C and 1800 mm bimodal rainfall yearly, distributed from September to December (Rosero 2005).

Identification of producers: The selection was done, taking into account the producers interested in using this type of technologies and that were currently working in agriculture and/or cattle raising. Three groups were formed that would contribute their diverse experiences, while we would learn from them and together form a work team (Producers-IPRA Project-Tropical Forages Project) to solve certain questions as to the different uses, forage conservation techniques and the evaluation of the same.

In-field evaluations of materials and technologies: Open-ended evaluation formats were used with the producers initially to obtain basic information about utilization and management in forage conservation so that they can determine which of the techniques is favorable; silage making in different-sized cylindrical metal drums or in plastic bags, as well as the field performance of the two forages (cowpeas and hyacinth beans).

Producers making the silage, CIAT-Santander de Quilichao.

Analysis of outcomes (partial): The data obtained from the surveys were tabulated, systematized and then analyzed using logistic regression in the analysis of preferences, an application for Excel v. 7.0 (Microsoft) developed by Hernández (2000).

Outcomes (partial)

Acceptance of the plastic bag technology was from intermediate to low, given that it is not very reliable (much air remains), and there is a perceived greater risk in the lower level of compaction achieved. In the cylindrical metal drums, on the other hand, acceptance is from good to intermediate because the form of storing the material represents more security and the silage is perceived as being more compact. They recommend that the drum be fixed to the ground so that it does not lift up and there can be better compaction and uniformity. They also suggested using other materials such as polypropylene drums to obtain more volume. Another group suggested a larger size container and doing a cost/benefit analysis.

In the field evaluation of materials, the farmers coincided with the cattle ranchers. Cowpeas were preferred for their diverse uses: the grains for human nutrition, animal nutrition, additional source of income, precocity (4 weeks), and the lower incidence of pests/diseases ("resistance"). The cattle ranchers were interested in the quality and quantity of the forage in order to improve their hillside conditions. In addition to the foregoing, the combined group was interested in learning about the potential market and its use as an economic alternative.

There were no differences for the hyacinth bean either; however the producers coincided in the fact that there was a high incidence of the leaf miner, which affects its production; thus its development was more delayed. The cattle ranchers mentioned that palatability is important to consider when taking a decision, an aspect that the other two groups did not mention. All groups mentioned that the hyacinth beans have very important traits: their capacity for regrowth, potential use as a cover crop, resistance and the absence of tannins, which affect the nutritional quality of any promising legume.

Conclusions (partial)

Both the cowpeas and the hyacinth bean were well accepted in work that results in the improved well-being of both people and animals. The technology of making silage in plastic bags had the lowest acceptance in the three groups of producers because the silage was more difficult to compact, the plastic bags can break, and it is more difficult to remove the air during the process. The silage made in the cylindrical metal drums had the best acceptance in the three groups because the drums are more resistant, and the air can be removed more easily.

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Diagnosis of the Use of Organic Wastes and Chemical Evaluation of Some Mixtures Used in Composting in the Area of Influence of CIPASLA, Pescador, Cauca

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Accomplishments

- Information was obtained from farmers regarding the use of and management practices for organic wastes in the town of Pescador, Cauca.
- The use of compost as an organic fertilizer is contributing to increased crop yields and to improving environmental quality (e.g., utilization of waste products, recovery of soils, less incidence of pests and diseases, and fewer unpleasant odors).

Abstract

This project was implemented in the town of Pescador, Municipality of Caldono, Northeastern Cauca Province (Colombia), with the purpose of identifying the availability of waste products for use in compost and describing the experiences with composting that are currently being done in Pescador. Producers that implement compost practices and rural agroindustries with products common in the zone and that generate byproducts in their productive processes were identified. Two surveys were applied to document the detailed record of the local knowledge. In addition, the procedures applied by three farmers for setting up their compost piles were monitored. At the onset of the process, three compound samples were taken from each compost pile for chemical analyses. The results refer to the quantification of the waste products generated in each of the production systems, the periods of production, their uses, identification of the commonest proportions of waste products and substrates used in a compost system, and finally the chemical analyses of the nutrients. Emphasis is on the producer's assessment of the organic waste products, the importance of using compost to recover soils, and how to combine the waste products. Study tours are recommended for promoting the exchange of knowledge among producers who are familiar with these practices in order to socialize their knowledge and promote the generation of initiatives that facilitate their implementation and management.

Keywords: Compost, microorganisms, organic fertilizers, organic wastes, environmental quality

Background

For many years the waste products resulting from different production systems have been a life threat, due to the immense volume produced and the large pollutant load they generate as a result of the level of development that motivates consumerism. Thus the problem gets

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worse every day. To control and/or mitigate the increase in waste products, it is necessary to take urgent measures and thus prevent their negative impact (Bruzon 1996). Composting makes it possible to utilize organic waste products that would normally be taken to a garbage dump or, worse, in rivers. A substrate fertilizer known as compost is produced to improve the quality of the soils. The majority of organic wastes are generated in the rural zone, generally from agricultural and livestock activities: coffee pulp, waste products of sugarcane processing, chicken manure and cassava solid wastes, among others. It is in this zone where this management practice should be used at the farm level and taken advantage of to mitigate the impact caused by their incorrect disposal.

Objective

Evaluate the management of organic wastes used in composting by documenting the experiences in composting in the zone of influence of CIPASLA (Interinstitutional Consortium for Agriculture Sustainable on Hillsides) in Pescador, Cauca.

Methodology

The work was implemented in the town of Pescador, Municipality of Caldono, Cauca Province, located at 2° 50' 25.1"-2° 45' 0.9" lat. N and 76° 32' 35.1"-76° 29' 44.9" long. W and 1290-1970 m alt., classified as pre-Montane dry forest, a temperature under 24°C, rainfall from 800-2100 mm, and an uneven topography with very strong to moderate slopes. Producers that carry out composting and rural agroindustries that generate byproducts in each of their productive processes were identified in the zone. Two surveys were designed for the population in order to obtain a detailed record of the local knowledge:

- Compile information about the amount and availability of byproducts that could be composted and identify the producers that do composting
- Record the details and document the experiences in composting. Georeferencing of the farms of each producer was done, using a GPS[110] Garmin Etrex. The population sample was selected at random, visiting three (3-5) farms per village in CIPASLA's area of influence.

Local knowledge: The procedure applied by three farmers for setting up their compost piles was monitored (Fig. 1).

- *Sampling of compost for chemical analyses*
  The samples were air dried, ground (< 2 mm) and then taken to the Analytical Services Lab at CIAT in order to determine the C, N, P, K, Ca and Mg contents.

110. System of global positioning for navigating in time and distance, based on signals transmitted by the Constellation of NAVSTAR (Navigation Satellite Timing and Ranging) satellites. These signals are received by portable receptors on land and serve to provide precise geographic positioning in any part of the world (Garmin Ltd.© 2005).

Figure 1. Steps followed by a producer in setting up a compost pile.

Results

Documentation of experiences:

Quantification of waste products

The producers surveyed produce waste products primarily from the kitchen (93%) and coffee pulp (89%). From 64-68% generated waste products from the garden and bean pods, 54% from maize hulls, 36% from cattle manure and 21% from chicken manure. There are other byproducts generated by less than 10% of those surveyed in nontraditional systems in the zone; e.g., cassava starch impurities containing protein, which are generated during the agroindustrial processing of sour starch, which is common in this zone of the Cauca Province. About 90% of the farmers in this watershed grow cassava (Hernández, 1996).

Cassava solid wastes, high in fiber content, are not a common waste product (only 7% of those surveyed produce it), but the amount produced yearly is high (average of 474 t/yr), which is also true for cattle manure (produced by 35% of those surveyed), with an average production of 7.9 t/yr. Although the waste products from the kitchen were the commonest (93%), the average volume generated by the producers surveyed was not high (1.4 t/yr). Most of the producers surveyed produced kitchen waste (93%) and coffee pulp (89%). From 64-68% of them generated waste products from the garden and bean pods, 54% maize hulls, 36% cattle manure and 21% chicken manure (Fig. 5).

Other types of waste products that are also generated (others in Fig. 5) include cassava starch impurities and solid waste, plantain bagasse, suckers or pseudostems, pig manure, ashes, leaf mold from the forest, chicken feathers, horse manure and guinea pig manure; but only a few of those interviewed (< 10%) generated such products. The byproducts referred to in the previous paragraph are produced in nontraditional systems in the zone. The exception is the cassava starch impurities, which are generated during the processing of the same on an agroindustrial scale and are common (90% of the farmers in this watershed) in this zone of Cauca Province (Hernández 1996).

Periods of waste product production

The production of coffee pulp is frequent; and it is one of the waste products generated in the largest amounts in the zone. The two periods of coffee production during the year are the main harvest from March-June and a second minor one from October-December. The maize hulls and bean pods are produced during the harvesting periods for this type of crops, and the frequency varies among producers, given the different periods selected for the planting. The periods of waste generation are probably concentrated in the rainy season when there is more agricultural production with short-cycle crops like common beans and maize. Waste products from agroindustry and the kitchen are generated daily. Chicken manure (only from operations with 50-250 broiler chickens) is generally produced semesterly, quarterly or every four months. Differences in the periods of production or generation of waste products depend on the dynamics in the production systems, the climate, rainfall/dry season periods

Commonest waste products and substrates used in the compost by the producers surveyed

Chicken manure is the waste product most used by those surveyed (93%), followed by coffee pulp and agricultural lime (79%); however, blackstrap molasses, waste products from the kitchen, yeast, soil, cattle manure, bean pods, ashes, cassava solid wastes and waste products from the garden are also used by 25-68% of the producers. Other waste products such as leaf mold from the forest, maize hulls and cane bagasse are also used, but by only a few producers (9%). The chicken manure, agricultural lime, blackstrap molasses and yeast are substrates purchased on the local market. These substrates are used to accelerate the decomposition and enrich the final product. According to INTEC (1999) these substrates contain a combination of microorganisms and important nutrients to initiate and accelerate the process.

Composition of a compost pile

Based on the information supplied, chicken manure and coffee pulp generally account for 20-40% (in weight) of the compost piles of the producers surveyed. In general, the producers feel it is necessary to use agricultural lime and blackstrap molasses, but they represent less than the 5% of the pile. The waste products from the kitchen are used in a proportion (based on weight) that ranges from 0-10%. Cattle manure has the greatest variation in the proportions used (0-40%). Few producers use waste products from the garden or yeast (0-5%). The other waste products are not much used by the producers.

Use and application rate of the compost in the different crops

The largest percent of producers surveyed use their compost on their coffee crop (22.2%); however it is also used frequently on common beans, plantain and maize crops (18.1%, 15.3% and 9.7%, respectively. While it is applied in larger amounts to fruit, plantain and vegetable crops, approximately 3-5 kg compost/plant is applied to plantains; but a few producers use up to 50 kg/plant, which increases the variability in the data. The application rate in coffee ranges from 1-3 kg compost/plant. The average application rate for the other crops is low, without distinguishing between minimum and maximum amounts (0.2-1.5 kg compost/plant on the average). In the case of quarterly crops like common beans and maize and yearly crops like cassava, the amounts used are always constant (0.2-0.5 kg/plant). These three crops are planted in association. Costa et al. (1991) suggest that a suitable application rate for compost is from 20-50 t/ha for crops with a large need for humus and from 25-40 t/ha for forage crops. The application rates used by the producers are similar to the recommendations found in the literature.

Criteria for evaluating the maturity and stability of the compost

The producers that do composting have criteria for evaluating the maturity of the compost, which determine when it is possible to use it. The ease of managing the compost with respect to its texture is the most frequently mentioned criterion among the producers surveyed. However, other criteria such as stable temperature of the compost (same as the environmental temperature), low level of unpleasant odors, low percentage of moisture (dry compost), and the change of color (dark) also serve, according to the producers, to determine when the compost can be used. The producers' criteria are consistent with the parameters indicated by various authors; e.g., Costa et al. (1991) and Labrador (2001) consider that one of the most useful methods for determining the maturity and stability of the compost is observing odor, stable temperature, color and specific weight.

Advantages/disadvantages of using compost according to the producers

Among the advantages, according to the producers, the effect of the compost on increasing production stands out, especially in coffee and common beans (32% of the responses). The producers also consider that the compost is an excellent fertilizer. This criterion was taken into account by 10 producers (21.7% of the total criteria) and is consistent with what is stated Restrepo (1996). A few producers mention that the compost has some disadvantages, especially when there is inadequate management of the system. One important disadvantage is the low availability of the phosphorus in the compost obtained. The producers also assume that an important disadvantage is the low availability of phosphorus in the soils in the zone, which should be reflected in the compost. The lab analysis shows phosphorus levels within the range mentioned by Cubero (1994), from 0.1-1.6%.

Mixture, composition and production costs for a typical compost pile

With the cost estimates of the three producers and using 1 ton as a basis for the calculation, the production costs were estimated, assuming 30% losses during the process, leaving 700 kg at the end. In fact, García (2000) mentioned that from 12-50% reduction in materials can occur, depending on the materials used. With an estimated 30% losses, a value of $126.20 was reached, which is the cost for the producers surveyed to produce 1 kg of compost. The production costs of the compost are high, taking into account that this is close to the amount suggested by Gómez (2000) for commercial purposes ($150/kg). For organic fertilizers (products with an NPK content ± 4%). (Restrepo 1996, Bongcam 2003) mention that the prices for the chemical fertilizers, as compared with those for the compost, are low (approx. ratio of 1:10). For this study, however, the ratio was 1:7.5 (i.e., 7.5 kg of compost per kg of chemical fertilizer).

Case studies

To establish a compost pile with the waste products, the three producers first clean the area where the pile is to be built. They prepare the waste products and substrates to be used in the system ahead of time. The coffee pulp, chicken manure, dolomitic lime, blackstrap molasses and yeast are used by the three producers; while the cassava solid wastes and Calfomag were used by only two of them. Other waste products and substrates such as agricultural magnesium sulfate, *buenazas*[111] Biosolnew,[112] rice husks, earthworm vermicompost, mature compost, bean pods and *nacedero* leaves were used by some individuals. The waste products are placed in layers. Generally the waste products of greater abundance are placed first. The blackstrap molasses and the yeast are mixed beforehand in a minimum of 10 lt of water. This mixture together with the lime is added as the layers are added.

The three producers' compost: The proportions of coffee pulp used by the three producers ranged from 22-32% of the total weight of the mixture. Chicken manure is used in proportions that go from 8-22%. To condition the moisture in the pile, the producers add water until the moisture is suitable, which they test with their clenched fist.[113] The blackstrap molasses is used in proportions of 0.4-0.6%. The use of the cassava solid wastes varies among the producers (23% of JB's pile versus 53.5% of CT's pile). However, both producers recognize the benefits of using the cassava solid wastes based on previous experiences, where they obtained the compost in less time (22-30 days) and better results in their crops. Other waste products and substrates also used include small percentages of nacedero leaves, bean pods, rice husks, buenazas, yeast, Biosolnew and agricultural magnesium sulfate—all used separately. The coffee pulp has ideal characteristics for compost as it has a high sugar content (source of energy), a good C:N ratio (25:30) and a suitable particle size (Restrepo 1996, Soto and Muñoz, 2002).

Chemical analyses of the composts

Carbon content

The analyses of variance showed significant differences for carbon contents in the compost; however, the compost systems had suitable levels (from 23-29%, Table 1). In general all the compost systems, independent of the waste products used, had an abundance of this element; thus they are considered organic amendments (Costa et al. 1991). However, it is important to clarify that the chemical analyses for the three systems of compost were done at the initial stage of the process, given the impossibility of carrying out a sampling at the end of the process. According to Gómez (2000) the amount of carbon is not constant in the compost process, varying considerably over time, especially if it has not undergone a good period of maturity. The percentages are given on a dry basis with respect to the total nutrient content.

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111. Mixture of plants that grow where they are not wanted, generally have no economic value and interfere with crop growth and harvesting, but are beneficial for this type of practice after pruning.
112. Organic soil amendment, ideal accompaniment for leaf and soil fertilization with both macro- and micronutrients, which helps assimilate the same given their power of chelation and complejation.
113. Consists in taking a fistful of the mixture and squeezing it; there should not be any drops of water between the fingers, but it should form a brittle lump (Restrepo 1996).

NPK contents
The analysis of variance showed highly significant differences ($p<0.001$) for said contents among the composts. RM had the highest NPK values (3.35%), while JB had the lowest values (2.84%) (Table 1). It should be noted that the NPK contents were within the ranges reported by Cubero (1994), who mentioned values from 0.4-3.5% for nitrogen, from 0.1-1.6% for phosphorus, and from 0.4-1.6% for potassium. Two of the systems evaluated (CT's and RM's) had P contents of over 0.5% despite having highly significant differences. The K contents ranged from 1-1.5% for the three compost systems, which is relatively low, considering that they can decrease during the process of stabilization or in the final stage.

Ca and Mg contents
The three composts had highly significant differences ($p<0.001$) for Ca and significant differences ($p<0.05$) for Mg. That of producer RM had the highest values for magnesium and calcium (1.3% and 4.73%, respectively). The high contents of exchangeable bases in RM's compost are apparently related to the proportions of dolomitic lime added to the pile and the additional use of agricultural magnesium sulfate (0.8%) and Calfomag (1.3%).

Table 1. Composition of nutrients in the compost analyzed.

	Nutrient Content (%)						**Ratio**	
	C	**N**	**P**	**K**	**Ca**	**Mg**	**C/N**	**C/P**
CT[2]	28.28 a[1]	1.22 a	0.61 a	1.20 b	1.64 a	0.31 b	23.09 a	46.34 a
JB	25.94 a	1.41 b	0.42 b	1.01 b	1.05 b	0.32 b	18.48 b	61.87 b
RM	23.12 ab	1.03 c	0.85 c	1.48 a	4.73 c	1.30 a	22.53 a	27.29 c
Prob(P<F)	0.0143	0.0016	0.0001	0.0103	0.0001	0.0001	0.0008	0.0001

1. Samples with the same letter are not statistically significant ($P < 0.01$) according to the ANOVA.
2. CT: Carlos Trujillo, JB: José Beltrán, RM: Rodolfo Muñoz.

C:N and C:P ratios
The C:N and C:P ratios also had highly significant differences ($p<0.001$) among the composts evaluated. The C:N ratio ranged from 18.48-23.09, the highest being in CT's compost and lowest in JB's (Table 1). The values of the C:N ratios for the three composts are not the best; in fact they fall below the average required for initiating the process. Labrador (2001) and Costa et al. (1991) mentioned that microorganisms generally use from 25-30 parts carbon to one of nitrogen. This ratio is considered optimal for materials that are going to be composted.

Conclusions

- Inorganic waste products are valued by the producers in the production of organic fertilizers as an alternative for replacing chemical fertilizers, achieving optimal results.
- The parameters that the producers took into account to evaluate and improve the functioning, efficiency and quality of the final product of a compost system were temperature, moisture, color and odor.

- In general, the producers mention that the use of the compost as organic fertilizer contributes to increasing crop yield and improving the environmental quality (recovery of soils, less incidence of pests and diseases, fewer unpleasant odors).
- The combination of cassava solid wastes and other organic wastes is important within the systems of compost evaluated, based on what was observed in the lab results. The compost that contains this waste product contributes the greatest content of nutrients and has the most efficient biological process
- The cassava solid wastes contribute excellent qualities including a variety of microorganisms and nutrients to the compost, which is reflected in the reduced stabilization time according to the producers (22-30 days) and to the higher nitrogen content (1.22 and 1.41%) with respect to the system that does not use this waste product (1.03%).
- In the compost analyzed, the C:N ratio was no better (18.48-23.09) and the C:P ratio registered values from 27.29-61.87. None of the composts evaluated falls within the optimal range for the two ratios, being lower than the average required for initiating the process (C:P 75-150:1 and C:N 25-30:1). Thus there is a need to increase the content of waste products rich in carbon to balance those ratios; e.g., add more vegetable leaves, harvest residue, wood shavings or ashes, etc.

Recommendations

- Build upon each producer's experiences with composting in an integrated and participatory process, given that everyone has criteria, which when considered together can generate viable and sustainable alternatives, contributing elements and criteria based on local knowledge, making the practice of composting much more viable among low-resource farmers.
- Promote study tours to exchange knowledge among producers that know about these practices, to socialize the knowledge and promote the generation of initiatives that facilitate their implementation and management.
- Agroenterprises that generate large amounts of organic wastes should use the composting technology, thereby contributing to minimizing the impact caused and generating a good-quality product that can be commercialized in the zone as organic manure.
- Given the simplicity of the practice of composting, it can be reproduced easily by farmers or agroenterprises in the zone and the rest of the country.

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Quinoa: Recovery of a Tradition

José Ignacio Roa V.[114]

Accomplishments

A series of innovations introduced by the members of the *Guambiano* Amerindian community in the Quisgo Reservation, Municipality of Silvia, Cauca, Colombia:

- The CIAL methodology
- Introduction of new varieties of quinoa (*Chenopodium quinoa*), an ancestral Inca crop of high nutritional value, adapted to the region, with a short period of only 5 mo to harvest
- A mechanical thresher
- Formed group of women leaders

Abstract

Guambiano woman evaluating whether quinoa is ready to be harvested, CIAL Tres Cruces.

The Quisgo Reservation is inhabited by 800 families, with an estimated population of 3000-4000 people. Each reservation is headed by an Indigenous Council, which is the maximum authority. In the Municipality of Silvia, Cauca Province, Colombia, there are six reservations: Quisgo, Guambia, Jambalo, Pitayo, Quilcalla and Tumburao. This article illustrates how a group from the indigenous community organized themselves with minimum resources into a Local Agricultural Research Committee (CIAL), how they were capable of taking decisions about local research priorities, and how they have been able to develop a process of innovating through conducting experiments. In response to the foregoing, both governmental entities and nongovernmental organizations are providing support so that the process can be developed on a larger scale. The CIAL is a local research service where farmer-leaders assume the responsibility for this activity before the community that has elected them. The CIALs conduct research in order to adjust agricultural technologies to the specific conditions of their communities, communicate the results and disseminate those technologies that prove useful in the region.

Background

In these communities there are always some difficult months when food becomes scarce. According to the CIAL (Local Agricultural Research Committee) members, the most difficult months are Febuary and March, when food becomes scarce because of the dry summer and April (Easter week) due to the rainy season. In September it is not so difficult because there

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is still maize stored from the previous harvest, which lasts depending on the amount planted and the consumption."*If we eat it every day, it won't last,*" says Esmeralda, Secretary of the Committee."*There are other foods that we vary so we eat other things. "The people whose maize does not last have to buy it in town, they get the money by selling firewood, milk or working as a day laborer.*

"In Easter week it is very difficult because of the rainy season and also the harvests have passed. What has been gathered, the maize and the common beans, have to be stored because here it gets very cold, and there are no options for planting something that will mature in 3 months, in other words, fast; it always takes time. For example, maize takes one year, the climbing beans almost one year as well, the bush types 4 months, peas 4 months; but they are not sure crops because if it is too rainy, they are lost and if the summer is too hot, they are also lost. So you have to play at both things, to lose or to win," says Esmeralda.

Esmeralda Solarte is a farmer, mother of three children; yet she finds time to participate in the Quisgo Indigenous Council in Tres Cruces, Municipality of Silvia, Cauca Province, Colombia, and is the Secretary of the CIAL. The leader of the CIAL is Mercedes Hurtado, who is single and lives with her mother, who is advanced in age. The Treasurer is Ángel Maria Hurtado and the Promotor, William Gonzáles. The Committee has created a new function, which is the Coordinator between the Indigenous Council and the Committee. The Committee works very closely with another eleven farmers.

The functions of the CIAL have been planning and coordinating the implementation of the trials on the farms of the local producers. They decide when, where and with whom to plant; the evaluations of the trials on the farms, the harvest and the analyses of the results. The Committee also organized a meeting after each harvest with members of the community to inform them about their activities and results. In meetings like those, it is when new ideas for conducting research with the CIAL arise; e.g., the trial with varieties of quinoa.

In 2000 the CIAL was invited to participate in an international seminar about participatory breeding in Quito (Ecuador), together with two other CIALs from the Cauca Province. The young farmers did not have any knowledge of quinoa at that time. Therefore Esmeralda saw it for the first time on her trip to Ecuador in zones similar to Silvia. The CIAL obtained seed from Ecuador via collaboration between the agronomists that support the CIALs in Ecuador and Colombia: Fausto Merino from the National Research Institute (INIAP) of Ecuador, and José Ignacio Roa from the IPRA Project at CIAT.

She explained: *"The idea of the quinoa was mine, after the trip to Ecuador, where we went to see their crops* [visit to INIAP's Santa Catalina experiment station]. *We had already worked with amaranth, which is very similar to quinoa. I had also heard of quinoa, but I had not had the opportunity to get some seed for planting. Then as a result of that trip, we had the opportunity and that was through you* [José Ignacio Roa, IPRA Project, CIAT] w*ho brought us the seed, which we planted here in Quisgo, The result has been really great."*

Objective

The IPRA Project saw the need to strengthen the local leadership in the communities and that was how it began to develop participatory methodologies through organized groups of farmers that like to do research (the CIALs). They investigate the causes that give rise to their problems and seek to solve them in order to improve their quality of life. They also seek to strengthen their degree of organization, development and sustainability so that in the end, the communities will be self-reliant in their own development processes. At the same time it is important that the communities recover their native knowledge under the leadership of their Committees to use it along with the new technologies that are produced by the research centers and that they evaluate them to learn which will adapt better to their specific conditions of soil, climate and cultural aspects.

The main objective of the CIAL Tres Cruces was to recover the tradition of planting quinoa, a millenary crop of high nutritional value, about 34% protein, and that the communities would begin to consume it again because it is a high-quality crop. Esmeralda commented that she has been looking for information on quinoa in collaboration with the UMATA (Municipal Unit of Agricultural and Livestock Technical Assistance) in order to share it with the community. Some of the older people commented that they had grown and eaten quinoa and that it was a traditional crop that was lost in the last generation. Quinoa has been one of the oldest traditional crops since the time of the Incas. The members of the Indigenous Council and the community in general are aware of the value of this innovation.

Methodology

In Ecuador the CIAL Flor Naciente has tested 15 varieties of quinoa supplied by the Legume and Tuber Program at INIAP (National Agricultural and Livestock Research Institute). Those varieties selected by the CIAL were then brought by the IPRA agronomist and delivered to the CIAL Tres Cruces. In 2000 the Committee planted a trial with the 6 varieties, following the steps of the CIAL methodology, first planting small plots to observe whether the varieties were adapted to the local planting conditions. All six varieties were planted on several farms at the same time, with the local planting system and fertilization in order to compare them.

The varieties rated as good by the CIAL were cooked and tested by the community in order to make the final selections and decide which would be replanted in larger plots called "Confirmation Trials." In this second round of trials they identified two varieties as the best: Cochasqui and Priotal. Then in 2003 the CIAL organized a field day with 30 women from 10 communities. "*We made cakes and salads, and served refreshments, all of them made of quinoa. What the people liked the most were the cakes,*" they said.
There was not sufficient seed available in the region. In 2004, the CIAL decided to plant three large plots of each of the two varieties on 3 farms. They still conserve the six initial varieties.

Results

Toward the end of 2004, four years after beginning the experiment, Esmeralda Solarte commented that almost 40% of the families in the Quisgo Reservation have planted at least one of the quinoa varieties selected by their Committee. *"The majority of the families in the*

*Quisgo Reservation had a small piece of land planted, not with much quinoa; now at least 300 families have planted quinoa"**

At present there are producers that have planted up to one-fourth of a *plaza* (1600 m^2) because they consider quinoa to be a new crop that still needs to be tested.

Cochasqui has a low level of saponin (a tannin that gives a bitter taste), which is white, better for cooking. The cakes look pretty, and they have a better flavor. The seed is being distributed in very small amounts among the producers.

The level of interest has been increasing. Esmeralda says that people have gone to her house, asking her to give them a little seed that they want to plant, or they trade quinoa for maize. *"I gave her half a pound, and she gave me 20 ears of maize. It takes only a little for a person to have enough to produce seed."* (the culture of bartering)

The farmers are planting quinoa principally as a subsistence crop to increase their food, and some are beginning to sell small amounts of seed. For example Mercedes Hurtado, leader of the CIAL, recently sold about 60 kg of quinoa as seed at Col.Ps.$2500 (US$1.00) to organizations and at $1500 (US$0.63) to the local farmers. The UMATA bought seed in mid-2004 to conduct an extension program with quinoa; by 2005 the farmers already had their seed.

The most important result is described by a CIAL member as follows:

> *"The idea is that all the families that live in the reservation plant it like they do maize, that they learn to consume it, and that above all, they give it to the children because it is a better food than maize.*
>
> *"The idea is also to distribute the quinoa in the schools to replace the Bienestarina Bienestarina (made of wheat flour, milk, soy flour, vitamins and minerals) and given by the Family Wellbeing Institute (ICBF) because the quinoa flour is more nutritious and it is also medicinal."*

Mercedes Hurtado commented : "*We have managed to decrease the incidence of tuberculosis quite a bit in older people and in children, thanks to the use of quinoa."*
At present they are not thinking about selling quinoa outside the region:*" First it has to be consumed in the reservation"*; in other words, they feel that after resolving their food security internally, they will think about comercializing quinoa, seeking new markets outside the region.

Quinoa is harvested manually. In order to cook it, a cuticle, a thin husk that covers the grain, has to be removed. The traditional procedure is to rub the grains between the hands. "*This is very hard work; many times my hands bled when there was quinoa in the region,*" commented an old indigenous woman who collaborated with the Committee.

The CIAL suggested getting some type of little "machine" to do this arduous work. The IPRA Project agronomist, José Ignacio Roa, and Mr. Humberto Muñoz, with extensive experience in building small machinery, created a prototype that was tested with very good results. The machine was tested on a field day attended by 30 producers, authorities of the Indigenous Council, UMATA technicians and CIAL members. They were impressed by the benefits that they could get from the thresher and are planning to plant the quinoa on a larger scale and begin to support the CIAL so that it plants and disseminates the quinoa varieties.

Later, among the Municipality of Silvia, the Indigenous Council and CORFOCIAL (Corporation for Promoting the Local Agricultural Research Committees), which groups the CIALs from Cauca Province, the CIAL obtained the resources to buy the quinoa thresher. The machine is kept in Esmeralda's house, and the producers borrow it, taking it to their homes to thresh their quinoa. The plans for 2006, commented Esmeralda, are "to adapt a small motor to the machine because they get very tired and the amount of quinoa has increased." The Committee is aware that a very important goal is to socialize the values of self-reliance among young people. Mercedes commented: *"Our task is to teach the children so that they recover the custom of eating quinoa, given that the children, seeing and teaching it, can learn and get ahead."*

The leaders of the Indigenous Council have been somewhat skeptical of the CIAL's work because some of them do not understand why they are planting these new varieties on such small plots. Nevertheless, their way of thinking about the research on quinoa has changed over time. At the beginning they were distant from the process, considering it as something small, "*a group of women doing something of little importance and with an unknown crop.*" Esmeralda's husband does not oppose her participation in the CIAL. If she has to go out for an all-day-long meeting, her family cooks for themselves. Mercedes, the other member, has to find someone to take care of her mother when she has to go out to attend the meetings.

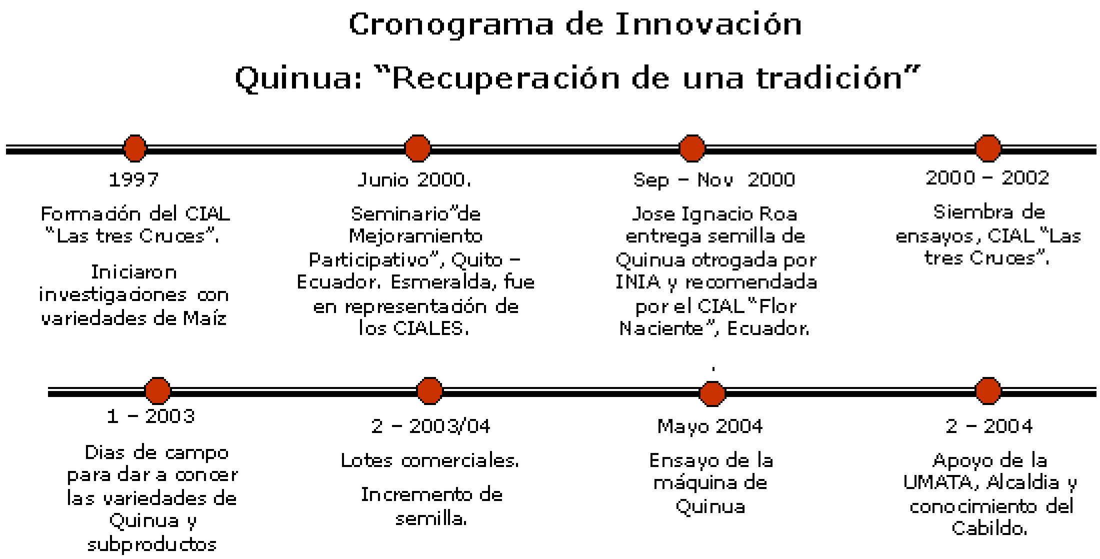
The Committee has increased its petty cash fund with the product of the sale of the seed from their experiment. Thus far they have saved Col.Ps.$220,000 (US$100), which they use to pay for the costs of their trials.

The CIAL is also visited by the UMATA, which has its office in Silvia, the capital of the municipality, population 13,000 inhabitants. The UMATA provides the CIAL with chicken manure, which is the source of organic manure to fertilize their trials. Their technicians observe the Committee's experiments. The UMATA is starting an extension program with quinoa in the five reservations of Silvia. It plans to give support to other producers for planting 10-20 ha of quinoa on a commercial scale, and the CIAL will have to produce the seed for this project. The Office of the Mayor has had a very important function: give support to the UMATA in this process by monitoring the harvests, visiting the trials and observing how the CIAL does its research.

CORFOCIAL's functions have been to facilitate the training in the CIAL methodology, provide access to the technical information, contact the CIALs and give support to the CIAL in the form of money for their petty cash fund and 50% for machinery.

The IPRA Project agronomist's functions are to monitor CORFOCIAL's progress, train or, if necessary, give support to the technicians in the research process and help CORFOCIAL to develop the CIALs in new ways. For example, the agronomist knew Don Humberto Muñoz, who designed and built the prototype of a thresher for quinoa, assuming the cost of constructing the first thresher. The agronomist brought quinoa from the CIAL so that they could test the thresher.

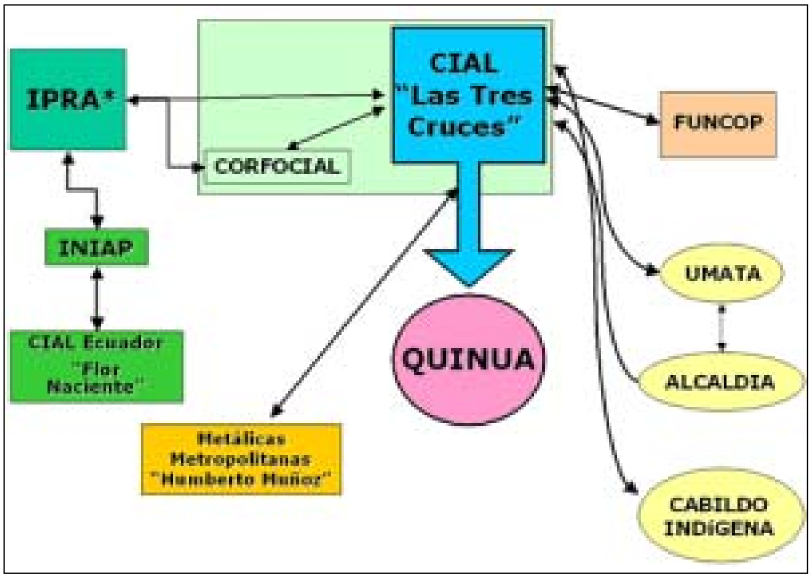
Mercedes Hurtado, member of the CIAL from Tres Cruces, identified the following as the most important lessons for other communities: *"I hope that our communities try to maintain our own native products because we know that our survival lies in growing the food we need and in conserving our native products and that while we have food, no one can make us leave our communities because we have a way to subsist, to survive."*



[Innovation Schedule of Activities // Quinoa: "Recovery of a Tradition // 1997 – Formation of the CIAL Tres Cruces – Began research on maize varieties // June 2000 – Seminar on Participatory Breeding, Quito – Ecuador. Esmeralda went in representation of the CIALs.] // Sept.-Nov. 2000 – José Ignacio Roa delivers the quinoa seed donated by INIAP and recommended by the CIAL Flor Naciente in Ecuador// 2000-2002 Planting of trials, CIAL Tres Cruces.

1 – 2003 – Field days to show the quinoa varieties and its byproducts // 2-2003/04 – Commercial lots. Seed multiplication// May 2004- Trial with machine for processing quinoa seed // 2 – 2004 – Support from the UMATA and the Office of the Mayor, and knowledge of the Indigenous Council]

[Ecuador CIAL…, Metropolitan Metalwork…, Quinoa, Office of the Mayor, Indigenous Council]



Network of stakeholders.

Conclusions

For a project to have continuity over time and enthusiasm by the communities, it is very important that the producers participate directly, from the initial selection of the problems to be addressed, to the planning of the activities that should be carried out with the objectives, to the evaluation of the varieties, to analyze the different stages and to keep the community informed so that they adopt the project as their own, which in this case is to spread the growing of quinoa to the other indigenous reservations.

All processes should be supported by training for the community and the leaders, as well as support for agricultural machinery if it is required so that in this case a greater number of indigenous communities can benefit.

Communication with the local organizations such as the Indigenous Councils, local government authorities (in this case, the UMATA) are also important so that they all support the project and feel like they are part of it.

It is comforting to listen to the words of CIAL member Mercedes Hurtado when she communicated in December 2005 that they had been able to reduce the incidence of tuberculosis in children and in the elderly in their reservation (Quisgo) due to the consumption of the quinoa.

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