Proposal of a methodology for conception sustainable development indicators for organic family farming

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1. Introduction

Planet Earth has undergone many transformations in the social scope with the important increase in the world population, mainly concentrated in urban areas and also in the environmental scope, in terms of temperature raise, which creates a great challenge for global and local policies in order to produce enough food with healthy, sustainable and responsible quality.

The prevailing model of food production in Brazil is industrial scale – agro-industry- and it has developed through the association of monoculture using great extensions of land, pesticides, intensive mechanization and the use of agro-industrial plants, thus contributing to the degradation level of natural resources, the environmental pollution, the extinction of the agricultural mode of production and, therefore, the concentration of income, population migration to the big urban centers and social inequality.

As a result of such situation, the concepts of sustainable development and sustainability appear to offer new alternatives for agricultural practices that adopt principles that promote the sustainable development of agriculture. The agroecology appears in the 1990s with the principles and epistemological basis considering that it is possible to reorient the altered course of how man use and manage natural resources in order to broaden social inclusion, reduce environmental harm and strengthen food and nutritional security by offering healthy food for all Brazilians (Carporal, 2009).

In Brazil there are already initiatives to stimulate the restart of the familiar agricultural production in a sustainable way and based on the agroecology model which aims to maintain the families in the rural areas of the country by providing conditions to sustainable production through agroecological input and management and the sale of healthy agricultural products enabling the increase in the family income and subsistence.

Among the alternative practices of sustainable farming one there is the organic farming which, according to the International Federation of Organic Agriculture Movements (IFOAM, 2005), consists of agricultural systems and products which fit into basic norms which exclude the of chemical fertilizers, artificial pesticides and herbicide and also genetic engineering and include long-term soil maintenance to enhance its fertility, compatibility with natural cycles and the maintenance of agricultural production. Niggli et al (2007), state that organic production systems may bring important contributions to empowering food through the means which provide soil fertility. As a result, the resilience of food may come from fertile and well-structured soils for it ensures bigger water retention and protection to the biodiversity. As a result, in organic farming the soils capture and store more water than in conventional growing (Brief, 2012).

Family farming, which, according to Guanziroli e Cardim (2000), is featured as the one growing in which the aim of tasks on the premises is decided by both the producer and his family. Family work force is superior to hired work and the area of the property is within a limit set for each region of the country. According to Sousa et al (2005) such way of farming has demonstrated characteristics of adaptation and feasibility, once it is not only a way of generating jobs and income in the rural areas but also a way of developing sustainable production. According to 2006 census (IBGE 2009), family farmers accounted for 84% of the farms in the country and occupy 24,3 % of the cultivated area employing 74,4 % of the work force in the sector. Family farming, even being practiced in small areas, represents 32 % of agribusiness GNP, which corresponds to 10 % of Brazil’s GNP.
According to Blanc (2009) the increase in the organic sector in Brazil has been seen as a lever to the social emancipation of small family farmers thus becoming an agroecologic alternative for farming in this segment. In 2003 Brazil was introduced a legislation in which the government declared his will not only to regulate organic production but also to turn it into a lever to developing small scale agriculture (Bellon, Abreu, 2006).

In that sense, ecologically based family farming matches the sustainability model for it gathers a group of techniques that aim to reduce the dependence on external energy and environmental impact and to obtain products with better quality, adding value to the producer, his social bases, labor, culture and territory. Moreover, it is important that sustainable usage of resources and the sharing of benefits for the biodiversity that can enable adequate processes of technological innovation and diffusion in activities and traditional practices of natural resources usage.

In the context of development and sustainability, according to Silva (2011), the production model that has been applied to family farmers in the Territory of Borborema in Paraíba-Brazil, has searched for alternatives to growth based on the Agroecology, designing economically viable activities which employ great part of the family work force and avoid the contamination of the environment.

Facing that reality it is necessary an ongoing analysis of the development level of such communities as a way of measuring the development generated by the activity organic farming.

The Indicators of Sustainable Development (ISD) are a preliminary guiding tool to analyze the level of sustainability a place or a location has. Silva et al (2010) emphasize that the indicators of sustainability are used a standard tool (...) they work as a basis for the analysis of development which have several dimensions (including environmental, geographic, cultural, social and economic factors), once they allow to verify the impacts of human actions in the environment. Based on these aspects aforementioned it is possible to evidence the statement of Candido et al (2010), which emphasize the importance of developing tools and/or indicators related to sustainable development in order to measure it, as well as afford data which externalize a socioeconomic, demographic, institutional, cultural and environmental reality of a country, region or location, thus responding to the complexity which involve new developmental model.

From such considerations, the current article presents a proposal of conception methodology for development indicator systems set to familiar organic farming on the aspects of production, productivity, sustainability and human factors in order to help family farmers to monitor, take decisions and then improve the production management as well as offer a set of information which will work as subsides to managers for the formulation and implementation of public policies that provide adequate conditions for the process of local sustainable development.

2. **Organic family farming on Territory of Borborema-PB**

The territory of Borborema-Paraíba-Brazil, as described in the executive summary of the territorial plan of Rural Sustainable Development (2010), occupies an area of 3.341,7 km², it has 21 municipalities and is located in the mesoregion of Agreste Paraibano, bordering Rio Grande do Norte to the north, Pernambuco to the south, the mesoregion of Mata Paraibana to the east and the mesoregion of Borborema to the west. It occupies 23,1% of the Estate of Paraiba.

According to AS–PTA (2012), the introduction of the planting of potato (Solanum tuberosum L.) in the area started in the 1930’s and increased in the 70’s and 80’s by means of governmental support. However, the activity was conditioned to monoculture and the use of pesticides and chemical fertilizers. Over this period, according to Silva et al (2013), many agricultural families who practically lived in the diversification of production systems were changing their means of production into a model of agriculture specialized in the culture of potato, making it the main commercial crop in the region. Due to the adverse conditions of weather, lack of rain, low natural soil fertility and the withdraw of the governmental investments plus the competition from the states from the South and Southeast of the country, the farmers could not keep their specialized production of potato in the territory of Borborema-Paraíba in a competitive way, which started the potato crisis in the semiarid Agreste region of Paraiba.

According to Silva et al (2013), among the 21(twenty-one) municipalities in the Territory of Borborema, seven (Remigio, Lagoa Seca, Areal, Montadas, Esperança, Lagoa de Roça e Alagoa Nova) have since 2010 been involved in the process of revitalization of the agroecological potato through Family Agriculture assisted by the NGO (Non-governmental organization) AS–PTA (Agroecological Family Agriculture – Program Paraíba). To articulate and lead the process of revitalization, it was formed a Territorial Commission.
of the Agroecological Potato, composed by the Union Center of Borborema, EcoBorborema (Association of Agroecological Farmers of the Compartment of Borborema), AS-PTA, SEDAPE (State Secretary of Agropecuary and Fishing), EMBRAPA Brazilian Company of Agricultural Research), EMATER (Company of Technical Assistance and Rural Extension) and BNB (Bank of the Brazilian Northeast). The main aim of the Commission was to build a participative approach in the process of forming farming families, in the system of production and commercialization and in the political negotiation among the organizations involved in the production of potato. In order to do so, meetings were conducted with the Commission, along with technical formation activities and exchange visits among the agricultural families to promote the empowerment of a great social network of experimenting farmers committed to the process of revitalizing the agroecological potato (Silva et al, 2013).

The reconstruction of the planting of potato is based on a new conjuncture which aims to produce healthy food in harmony with the environment and without the use of pesticides and chemical fertilizers thus rescuing some former production practices, such as the cultivation in joint systems of agricultural cultures such as fennel, beans, manioc, coriander and guandu beans. The assurance of access to the seeds though the annual potato storage in the cold store of the municipality of Esperança also provides a new panorama for the production which strengthens the continuity of the revitalization of the culture in agroecological basis. (Silva et al, 2013).

The process of revitalization started in the beginning of 2010 through an experiment with 3 varieties of potatoes (BRS Elisa; BRS Cristal e BRS Catucha) made available by EMBRAPA – Pelotas-RS unit. In the year 2011, the government of the Estate of Paraíba, through the SEDAPE made available 940 boxes of seed potatoes, which were distributed to the families of farmers in the Territory of Borborema. 49, 47% of the 43.239kg of potatoes were stored in the frigorigific chamber of the municipality of Esperança- PB, the farmers then used part of the production to multiply the seed potatoes to be replanted by themselves and by families not participating in the program in 2011 (SILVA et al, 2013). The productivity of the seed was 46 kg/box in 2011.

In 2012, according to Silva (2013), 104 family agriculture properties involving 53 communities of seven municipalities (Remígio, Lagoa Seca, Areial, Montadas, Esperança, Lagoa de Roça e Alagoa Nova) planted 984 boxes of agroecological potatoes in an area of approximately 21 hectares. The fields for producing potatoes were prepared using animal traction and the seeds were sowed with a space of 0,30m x 0,80m. In the fertilization of the potato fields, cow manure was incorporated, approximately 12 t/ha. The cultural tracts consisted in the use of manual weeding and foliar pulverization of liquid bovine biofertilizer. The production of potatoes in the year 2012 was 89.250kg with average productivity indicators of 4.250 kg/hectare and 90,70 kg/box (kg of potatoes produced by box of planted seeds), 97,2% above the productivity of 2011.

Table 1 shows the annual production of potatoes in the Territory of Borborema in 2011 (43.239 kg), 2012 (89.250 kg), 2013 (212.716 kg) and 2014 (270.944 kg), the quantity of seeds stored in the cold storage in the municipality of Esperança, sold, consumed by the agricultural families and the losses (counted only in 2014).

Table 1. Production of agroecological potato by family agriculture in the Territory of Borborema-PB: 2011 - 2014

<table>
<thead>
<tr>
<th>Year</th>
<th>Stock seeds\n\n(Cold Storage)</th>
<th>Consumed by the agricultural families</th>
<th>Sold</th>
<th>Losses</th>
<th>Total Produced</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(kg)</td>
<td>(%)</td>
<td>(kg)</td>
<td>(%)</td>
<td>(kg)</td>
</tr>
<tr>
<td>2011</td>
<td>21.390</td>
<td>49,47</td>
<td>3.590</td>
<td>8,30</td>
<td>18.259</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>42,23</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>2012</td>
<td>33.705</td>
<td>37,76</td>
<td>7.570</td>
<td>8,48</td>
<td>47.975</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>53,75</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>2013</td>
<td>41.650</td>
<td>19,58</td>
<td>17.444</td>
<td>8,20</td>
<td>53.622</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>72,22</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>2014</td>
<td>49.860</td>
<td>18,40</td>
<td>27.235</td>
<td>10,05</td>
<td>172.922</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>63,82</td>
<td></td>
<td>20.927</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>7,72</td>
<td></td>
<td>270.944</td>
</tr>
</tbody>
</table>

NOTE: * Unaccounted data
Source: ASPTA - Agroecological Family Agriculture – Program Paraíba.

In the year 2014, 270.944 kg of organic potatoes were produced, out of which 49.860kg (18,40%) were stored in the cold storage in the municipality of Esperança to be used as seeds, 27.235 kg (10,05 %) were
consumed by the producing families and 172.922kg (63.82%) were sold. The losses in the year 2014 represent 7.72% (20.927 kg). (Table 2)

Considering the total produced in 2014, 63.82% were sold at the average price of R$/kg 1,25, in the following manner: Institutional Market (PAA – Program for Acquiring Food and PNAE – National Program of School Food); (44.372kg, R$/kg 1,79), middleman (42.190 kg; R$/kg 0,69), commercialization with neighbors (29.150 kg; R$/kg 0,92), agroecological markets (26.81kg; R$/kg 2,10), Paraíba Company of Supplying and Agricultural Services - EMPASA (22.600 kg; R$/kg 0,73) and street markets (7.800 kg; R$/kg 0,96). It is stated that though the PAA is the biggest consumer and generates the biggest sales (R$ 79.584,74), the value sold R$/kg 1,79, does not correspond to the best price obtained, which is R$/kg 2.10 in the agroecological markets, where the product is sold directly to the consumer. The middleman buys the product by the smallest price, R$/kg 0,69, having bought 42.190kg in 2014, which corresponds to 24,4% of the total production.

Table 2: Production Flow of agroecological potato by family agriculture in the Territory of Borborema-PB - 2014

<table>
<thead>
<tr>
<th>Production Flow</th>
<th>Quantity</th>
<th>%</th>
<th>Unit Price</th>
<th>Turnover</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total produced</td>
<td>172.922</td>
<td>100,00</td>
<td>1,25</td>
<td>215.740,64</td>
</tr>
<tr>
<td>Street markets</td>
<td>7.800</td>
<td>4,51</td>
<td>0,96</td>
<td>7.482,00</td>
</tr>
<tr>
<td>EMPASA</td>
<td>22.600</td>
<td>13,07</td>
<td>0,73</td>
<td>16.600,00</td>
</tr>
<tr>
<td>Agroecological markets</td>
<td>26.810</td>
<td>15,50</td>
<td>2,10</td>
<td>56.230,00</td>
</tr>
<tr>
<td>Commercialization with neighbors</td>
<td>29.150</td>
<td>16,86</td>
<td>0,92</td>
<td>26.723,90</td>
</tr>
<tr>
<td>Middleman</td>
<td>42.190</td>
<td>24,40</td>
<td>0,69</td>
<td>29.120,00</td>
</tr>
<tr>
<td>Institutional Market</td>
<td>44.372</td>
<td>25,66</td>
<td>1,79</td>
<td>79.584,74</td>
</tr>
</tbody>
</table>

In the context of development and sustainability, the production model which has been worked with the family farmers in the Territory of Borborema is based on the diversification of the production systems and involves the agricultural production (potato, corn, fava beans, beans, peanut, fennel, manioc, sweet potato, pumpkin, courgette, kale, lettuce, tomato, spring onions, coriander, sugar cane, elephant grass, palm coconut, guava, guanabana, banana, cashew fruit, sabiá -Mimosa caesalpiniaefolia, pencil cactus, neem, gliricidia) and the animal production (beef, pork, poultry) has searched for alternatives to the cultivation of Agroecology, economically viable, directed by family workforce, simple and accessible technologies which promote improvements in the productivity and avoid the contamination of the environment.

3. Proposal of a methodology for conception sustainable development indicators for organic family farming

AGROINDEX modeling was inspired by the method of indicator elaboration applied in the civil construction industry, which resulted in the System of Performance Indicators in ergonomics for building construction – SIDECE (Bezerra, 2014, Bezerra; Carvalho, 2012) and features four models.

The methodology proposal in the system of sustainability indicators for organic family farming – AGROINDEX, has been conducted through Participative Ergonomics (Hendrick & Kleiner, 2006), associated to method of Ergonomic Work Analysis-WEA (Wisner, 1987; Guérin et al, 2001; Vidal, 2003).

Participative Ergonomics refers to the process of involving people in the plan-ning and control of a significant part of their own work activities, with enough power and knowledge to influence processes and results and to set desirable aims (Wilson, 1995, apud Hendrick, Kleiner, 2006).

The WEA comprehends a group of global, systematic and intercomplementary analysis which enable the modeling of real activity in its own context and considering technical, human, environmental and social factors (Vidal, 2003). It has been used as a reference the methodology of Work Ergonomic Analysis-WEA (Wisner, 1987, Guérin, 2001; Vidal, 2003). The WEA comprehends a group of global, systematic and
intercomplementary analysis which enable the modeling of real activity in its own context and considering technical, human, environmental and social factors (Vidal, 2003).

These methods shall be developed through a systematic process of social construction (Daniellou, 1988; Saldanha, 2004), which aims to involve and commit people who have technical competence, leadership and decision power in the farm communities, public power and pertinent institutions in order to construct this a system of indicators of that very nature.

The system of sustainability indicators for organic family farming AGROINDEX features 5 moments (Table 3): exploratory and field recognition research (Moment 1); conceptual modeling of the AGROINDEX indicators system (Moment 2); situated modelling of the AGROINDEX indicators system (Moment 3); development of the AGROINDEX Software (Moment 4); implementation (Moment 5).

Table 1. Methodological proposal for conception Sustainable Development Indicators for Organic Family Farming.

<table>
<thead>
<tr>
<th>Moment 1: Global Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploratory research and field recognition</td>
</tr>
<tr>
<td>Systematic Field Research</td>
</tr>
<tr>
<td>Interinstitucional Research</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Moment 2: Conceptual modeling of the AGROINDEX indicators system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modeling I</td>
</tr>
<tr>
<td>Phase 1</td>
</tr>
<tr>
<td>Phase 2</td>
</tr>
<tr>
<td>Phase 3</td>
</tr>
<tr>
<td>Phase 4</td>
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</tbody>
</table>

| Modeling II | Participative validation of AGROINDEX 1 Validation is the degree in which an instrument measures what it is supposed to’ (Polit, Beck e Hungler, 2004). For the current content and character validation, the first Agroindex Model shall be submitted to appreciation by a group of people, as indicated in Participative Ergonomics (Lynn, 1986 apud Alexandre, Coluci, 2011). Such validation will be performed from presenting a list of indicators through a likert scale of 5 alternatives so that the participants (family farmers, members of the Secretary of agriculture, IBAMA, fomentation agencies, NGO’s, researchers and professors among others) respond about pertinence, usefulness and practicality of the listed indicators. This modeling process is also to receive indications of other possible indicators from the research participants, which results in a second version of the Agroindex model – AGROINDEX 2. |

**Moment 3: Situated modelling of the AGROINDEX indicators system.**
Modeling III

Participative and situated validation of AGROINDEX 2
This modeling process concerns the application of Agroindex Model 2 in family farm communities in the region of Borborema in experimental and implementation character, which results in the Agroindex 3 Model – AGROINDEX 3

Moment 4: Development of the AGROINDEX Software

Modeling IV
Developing AGROINDEX Software to be applied and used by the communities.
This modeling process refers to the development of Information Technology (software) Agroindex and to make it available to the family farm communities in the region of Borborema in the estate of Paraíba-Brazil.
For a better understanding and comprehension of the results of Agroindex by the communities the results will be presented from a symbolic element of sustainability for the artisanal communities, such a tree, in which the leaves and fruit have different colors according to the sustainability level of each family/community, similar to the methodology “Arbre - Arbre de l’exploitation agricole durable” (Pervanchon, 2007, apud Costa, 2010). In this way, each community/family will acquire a global image of sustainability in their property according to the color of the tree, highlighting the strong and weak spots and allowing the search for continuous improvement, i.e., better sustainability levels.

Moment 5: Implementation

Modeling V
Implementing AGROINDEX release, training and final validation
Release and training for the use of Agroindex software in experimental character for validation and definite use by family farmers

4. Discussion

The relevance of the current proposal is to broaden the debate over sustainable development in family farming through the development, application and release of realistic system of sustainability indicators for family farming agriculture involving the aspects of production, productivity sustainability and human factors in an integrated way.

In that sense AGROINDEX aims to contribute to: Monitor the aspects of production, productivity, sustainability and human factors by the farmers themselves thus contributing in the search for sustainability and empowerment of families and the communities respectively; Decision-making by the family farmers that contributes to improve the production management on sustainable bases; Subside decision-making of the fomentation institution managers concerning the need of investments and results; improvement the management of projects of qualification and fomentation projects enabling the comparison of indicators before and after the interventions.; Release a set of information which will subside the managers to formulate and implement public policies that allow adequate conditions for local development..

5. Final Considerations

The current proposal starts from the premise that the assessment of sustainable development must take into consideration the local features and diversities from the understanding of the activity and its anthropotechnological context (Wisner, 1997), and also from a participative methodology (Hendrick, 2005). From the ergonomics point of view, the proposal of this project inserts itself in the field of anthropotechnology and macroergonomics. In summary, Macroergonomics (Hendrick, Kleiner, 2006) teaches us that optimizing solutions must be searched in the articulation between technical systems and people management systems with special attention to Human Factors. Anthropotechnology (Wisner, 1994) states that the single adoption of foreign methods and technologies in a country, different from corporate organizational culture has led into failure several processes of transference of technology and knowledge. Because of that, it is recommended to search for theoretical elements combined with the adjustment of some tools and inserted in a process of solution development adequate to the organization.

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