Analysis of the tomato harvest: a case study in eight brazilian farms
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The present study aimed to analyze aspects inherent activity of workers involved in tomato harvest in family farms in the State of São Paulo, in order to identify the constraints faced forward the task requirements and the tacit knowledge present in these workers practice. The research was conducted through an exploratory study that collected qualitative data from multi-cases through semi-structured interviews and observation of the worker's activity based partially on the activity ergonomics methodology. The present study aims to show that the work of workers involved in tomato harvest in family farms is translated by complexity, causing a variety of strategies in an environment with a large weather variability and where the tacit knowledge plays an important role in the development of strategies to deal with the labor constraints. Through the analysis in this case study activity, we can observe a wealth of knowledge arising from practice, that make these workers able to perform their activities in an environment of high complexity.

Practitioner Summary: It was conducted a case study in eight farms in country towns nearby São Paulo, Brazil. Twenty three workers participated of this research. In order to obtain a preview of the job organization, our study perspective evolved the following methodological resources: visits to the farms, semi-structured interviews with workers and focus groups of discussion for data validation.

Keywords: tomato harvest, agricultural ergonomics

1. Introduction
Agricultural work presents grounded by a universe of constant variability and uncertainty, which leads workers to develop strategies as a leeway to overcome the constraints arising from their work practice (Montedo and Sznelwar, 2008). The tomato is presented as a vegetable of great economic importance for the state of Sao Paulo, Brazil. Manual harvesting of tomatoes is present in most of the family farms that grow this fruit. According to Abrahao (2003), agricultural work is characterized by poorly structured tasks that often require considerable physical effort, awkward postures, unfavorable environmental conditions, exposure to chemicals, seasonality and handling multiple devices at the same time, which creates a wide range of risks to which workers are exposed. Thus, through the methodology of Ergonomic Work Analysis, the objective of this study was to find the variables that determine the strategies chosen by the workers to regulate and overcome the constraints from Activity-centered Ergonomics studies how worker regulates the activity according to its external environment, its internal state, the system and organizational features to ensure maximum consistency of performance with safety and health aspects (Wisner, 1997; Guerin et al., 2001). The study is grounded on the principles of ergonomics in the following dimensions: work organization, defense strategies, and the construction of a work team.

1.1 Theoretical Referential
Ergonomics means to harmonise work and the working environment to raise productivity and ensure health and well-being to workers through optimising labour through work transformations. Farms and farming systems have to adapt and become more efficient to meet the ever-increasing economic demands. Providing farmers with suitable means of production such as adequate tools and implements is one way of easing the burden and provide health and safety to these workers (Jafry and O'Neill, 2000).
In tomato harvest, workers have to deal with several aspects that do not depend on them and influence directly their work and performance. Workers have to create strategies to manage these aspects and achieve the expected results. When the objective is to analyse the activity of these workers, the rural sector requires a different approach from the industrial sector, because technological change is more alien, sociological and anthropological factors are relatively more important (Jafry and O’Neill, 2000).

An activity is always unique. To understand the world of activity in complex environments, as occurs in the work of the harvesters, Ergonomics appears as a method of analysis that can confront empirical data from observation and behavioral measures, generating a context of confrontation between the task and the activity (Gemma et al., 2010).

The Activity-based Ergonomic Analysis aims to identify a number of elements that modulate the activity of work at different levels, with consequences also on several levels. At all times we analyze how the work activity integrates these elements and how different rationalities that permeate the construction of this system are made manifest. The diversity of these elements, or variables that affect the work requires a complex look, which can allow a movement of linking the various dimensions present there, reconstituting the complexity involved in the work situation, so that the explanation ergonomicist makes sense for himself and especially for workers (Montedo and Sznelwar, 2008).

1.1.1 The case study

It was conducted a case study in eight farms in country towns nearby São Paulo, Brazil. Twenty three workers were selected to participate of this research. In order to obtain a preview of the job organization, our study perspective evolved the following methodological resources: visits to the farms, semi-structured interviews with workers and groups of discussion for data validation.

The observation was conducted for a whole day's work under based on and ergonomic view. We follow our protocol through observation, a semi-structured guide with open questions and self-confrontation at the end (for verification of the data), where the respondents checked the descriptions showed by the researchers. The description of the activities of these actors was performed using paper and pencil and subsequent transcription of the recorded speeches.

All subjects worked in the harvest for more than two years. The ages varied from 25 to 52 years old, with predominance (11 workers) between 31 and 42 years. There were 5 women and 18 men. The properties were different in size and type of tomatoes to be harvested. All were located in the state of Sao Paulo, Brazil. All properties counted to the harvest by hand, without the aid of tools or machinery specific. Our study were performed at the beginning of the harvest (when the tomato plants were still closed height to the ground).

It is important to explicit that the present study shows the partial results from a major study associated to a master’s degree in production engineering project.

1.1.2 Results

The results showed the following: the activity of the tomato farm workers is a evolved in a complex network of facts which is built upon the relationship with unknown circumstances (environmental, organizational and market issues) and requires strong subjective mobilization and continuous inventiveness.

Workers performed the following tasks during a working day: arrived at the site via own vehicles or cooperative contractor; guarded their pot at some shady spot (there was no appropriate place for this purpose); caught the buckets; walked up the tomato plants (planting); checked visually by where they should start harvesting; walked between tomato plants; visually they selected the fruit; drew the foot of the fruit; put fruit with good quality aspect in the bucket and threw down those with defects; to fill the buckets, went to the start of planting and dumped in plastic boxes that would led to the final destination.

These tasks were features a common working day, without climate interference. On rainy days, the harvest was not performed. In days of rain, the fruits were dirty land, which hampered their selection and the soil became more irregular, requiring more effort to maintain balance while moving. In hot weather, workers report slow down due to more constant need of hydration.

In tomato manual harvesting, workers have to detect the fruit using a visual search effort to observe color and several aspects related to quality aspects. The fruits cannot be harmed, smashed, with diseases or abnormalities. These workers have to select the fruit by discharging the ones that are not good for consume (Prussia, 1985).
The selection guides their activity. Workers choose their postures and deal with the aspects of the environment (as rain, sun, heat) with strategies that emerge through their work (Figure 02).

Highly repetitive manual sorting work is performed by large numbers of workers (Manz, 2013). Through activity analysis, the researchers could observe several adaptive factors identified in workers actions. These workers received their payments by hourly pay rates. Workers had choose in all eight farms observed to work in groups instead of working individually. The groups were organized to minimize fatigue (establishing in witch part of the ground each one would perform the harvest). At the end of the day, the payments were divided equally. Workers did not have tools to improve their productivity and reduce fatigue. Instead, they only carried buckets to put the fruits and then pour in the plastic boxes to final destination. Regarding to posture, we observed that the workers remained standing throughout the activity walkign through the plantation. Workers also performed flexion in lumbar, thoracic and cervical column and squatting posture to achieve the fruits located amid plantation. In the upper limbs, shoulder and elbow flexion associated with handle deviations were observed. The ground was irregular, demanding work balance. Harvesting is directly associated to environment conditions. Workers only performed their activities when they had the sunlight and absence of rain.
Workers had their activity observed by the producer and, when present, the worker responsible for the cooperative that hired them. This supervision influenced their work rate and the fruit selection process. Workers did not use personal protective equipment. They did not have training for correct use and related that the equipment worsened the heat sensation and gloves hindered the activity to pick the fruit, since it impeded workers to feel aspects of the fruit through their hand touch. Workers learned through the harvest own practice. Tacit knowledge appeared throughout the interview, where workers could not verbalize as identified aspects of fruit and selected strategies to decrease the task constrains. Workers selected their pace of work. They stopped to have lunch and do their breaks in the activity, but directly dependent on the influence of sunlight, since it depended on it to perform the harvest, and the supervision of the producer and contractor of the cooperative.

1.1.3 Discussion

The organization of work is submitted by the precariousness identified in the lack of resources, technology and environmental aspects that interferes directly in workers activity. From an ergonomics point of view, safety and health of workers are related to how the critical aspects of the task influence the workers activity. Workers have to transpose their mental and physical limits to achieve the results despite the constraints of the task.

Although agricultural work is often classified as a purely manual labor, it is understood that workers learn about their work and in turn are transformed by it, creating strategies to account the constraints and restrictions imposed on it. In this context, the tomato family farming relates to the high variability of the system, the vulnerability of farming to climate and market conditions, plus the precarious nature of rural work. Workers have to deal with complex aspects related to the production system and the consequences to their health. The workers did not report musculoskeletal complaints.

It is necessary to adopt preventive and protective measures to ensure that under all conditions of their intended use, all agricultural activities, workplaces, machinery, equipment, chemicals, tools and processes under employer’s control are safe and comply with prescribed safety and health standards. Although, the tomato family farming presents several aspects related to the lack of adapted technology and peculiar work organization, these aspects allow workers to conduct their activities using strategies related to time managing and to the organization of the collective work.

Workers have developed a collective job to handle the task constraints, harvesting and performing their breaks to reduce fatigue associated to labor practices. The tacit knowledge, acquired from practice, proved to be widespread among the workers.

The worker takes initiatives to make the system work, causing accidents management, anticipating actions, making simultaneous management of several factors at the same time, communicating and still unique in its activity amid the collective (Guerin et al., 2001).

Workers develop strategies acquired through the learning from their practice. The selection of postures that reduce fatigue, the choice of time breaks and the option to work collaboratively in groups show up as strategies to reduce the constraints arising from the own task. In an environment where several factors can not be controlled by the workers, these strategies aim to maintain their well-being to try to achieve the preset results (tomatoes boxes selected for specific aspects of quality).

The health of these workers is related to their ability to control, managing the variability according to the situations. The greater the variability of situations, the less likely anticipation, which requires greater competence of workers to contextualize its action to reality.

References


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