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Determining the Expectations of Farm Workers From Work Wears and Developing Functional Work Wear Models

Tarım Çalışanlarının İş Giysilerinden Beklentilerinin Belirlenmesi ve Fonksiyonel İş Giysisi Geliştirilmesi

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Abstract

Technological developments that occurred in the production of clothing allow the producing of clothing having different properties. Thus the concept of work clothes has emerged. In this research, primarily, a survey was conducted to determine expectations of employees' work wear in the agricultural sector. In continuation of the study, new work wear has been developed to protect the health and safety of employees. In the final part of the study, clothing experiment for fitting of body is subjectively evaluated. In order to assess the overall posture and fitting, eight male and eight female volunteers have been used for test subject and the volunteers' opinions were obtained on work wear using a questionnaire. Subjective wear trial results show that, unisex work wears for farm workers can be designed. It was also determined that, the model details affect to the body movement comfort and functionality of jumpsuits.

Keywords: *Agriculture, farm workers, work wear, clothing comfort, body fit, subjective wear trials.*

Öz

Giyim üretiminde meydana gelen teknolojik gelişmeler; çeşitli sektörlere yönelik özellikleri olan giysilerin üretilebilmesine olanak vermiştir. Böylece iş giysisi kavramı ortaya çıkmıştır. Gerçekleştirilen bu çalışmada; tarım sektöründe çalışanlar için; iş verimliliğini arttıran, çalışanı sektörden kaynaklanan risklere karşı koruyan, bunun yanında çalışanın vücut uzuvlarının rahat hareket etmesini de sağlayan giysiler geliştirmek amaçlanmıştır.Araştırmada, öncelikle, tarım sektöründe çalışanların iş giysilerinden beklentilerinin belirlenmesine yönelik bir anket çalışması yapılmıştır. Elde edilen verilerden yola çıkılarak, tarım işletmelerinde giyilebilecek, hem çalışanın sağlığını ve güvenliğini koruyan hem de hareket kolaylığı sağlayan giysiler geliştirilmiştir.Yeni geliştirilen bu giysilerin genel duruş ve vücuda uyumunu değerlendirmek amacıyla, sekiz erkek ve

sekiz kadın gönüllüye bu giysiler giydirilmiş ve oluşturulan subjektif skala ile gönüllülerin giysiler hakkındaki görüşleri elde edilmiştir. Subjektif giyim denemesi sonuçları, unisex işçiliğinin tarım işçilerine yönelik tasarlanabileceğini göstermektedir. Ayrıca model detaylarının beden hareketinin rahatlığını ve tulumların işlevselliğini etkilediği belirlenmiştir.

Anahtar Kelimeler: *Tarım, tarım işçileri, iş giysisi, giysi konforu, vücuda uyum, subjektif giyim denemeleri.*

1. Introduction

Technological developments during the recent years enabled producing clothing intended for various industries and thus caused the term "work wear" to come to light.

Work wear is used to prevent the risk of exposing to adverse environmental conditions, protect against it and to lower the risk [1]. It is well known that wearing unfit work wear leads to occupational accidents by restraining worker's movement and decreases productivity by decreasing worker's performance [2[.

Work wear is ideally designed to satisfy three aspects - function, symbolism, and aesthetics - in relation to the work activity for which it is designed. More emphasis tends to be placed on the function of work clothing than on its symbolic or aesthetic qualities. However, work clothing can be designed to include all these factors equally to create a working environment that is both physically and psychologically comfortable [3].

While designing work wear; visual design, material design and functional design come into question. In visual design; color of the clothing, shape of the clothing and decoration elements are dealt with. In material design, materials which have sufficient comfort properties should be selected. As for the functional design step, functional properties of the clothing should be determined in order to allow worker to move his/her body without restrictions [4].

In our literature review; we have come across studies about work wears used in petro-chemical, machinery, food and ceramic industries [1], about work wears used by the workers working in garbage collecting [5] and rest-stops [4], about work wears used by private security guards [2], correction officers [7], nurses [6] and policeman [8].

Agricultural sector always maintains its importance for both developing and developed countries. One of the sectors in need of special work wear which meets the expectations about clothing comfort is agricultural sector. In the study conducted by Yalçın et al (2016) information is given through examine of works and statistics on work accidents and illnesses of the people working in agriculture and during the use of chemicals, it is recommended that publication studies should be done to indicate the importance of the use of masks, gloves and protective clothing [9]. In the study conducted by Atalay et al (2018), 312 agricultural workers were questioned for their protection from pesticide exposure and it was found that 48.1% of agricultural workers were wearing to be exposed to pesticide [10].

We have observed that most of the studies about agricultural sector focused on protective clothing against pesticide [11,12,13], however studies about agricultural work wear ergonomic are limited. Choi and Ashdown (2001) designed an ergonomic work wear for pear picking workers [3]. In their study, McQuerry et al (2018) investigated whether a T-shirt with proprietary printed cooling technology could significantly improve the physiological and subjective thermal comfort of agricultural workers [14]. In a study by Arroyo et al. (2019), it was aimed to investigate the effects of working rate, hydration status and clothing on core body temperature (CBT) on California farmers [15].

In this study, initially a survey has been made to agricultural workers in order to determine their expectations about their work wear. Outcome data of this survey has been analyzed. In the light of the collected data, 4 items of work wear with different patterns have been developed. Fitting to the body, allowing to mobility and admissibility of these developed patterns have been evaluated by

wearing experiments which includes 8 female and 8 male voluntary volunteers. Moreover, in one pattern, two different fabric types have been used in order to determine the choice of volunteers.

2. Material and Method

2.1. Questionnaire study

In the questionnaire study of our research, a survey with 10 questions which aimed to determine expectations of agricultural workers from their work wear has been done with 100 participants. The participants were between 20 and 40 years old. The collected data have been statistically analyzed with the help of PASW Statistics 18 software. This study consists of 3 stages. In the first stage, a survey with 10 questions which aimed to determine expectations of agricultural workers from their work wear has been done with 100 volunteers. Data have been statistically analyzed with the help of PASW Statistics 18 software.

2.2. Development of work wears

In order to develop work wears, initially the data, which was derived from survey results, have been evaluated, present agricultural work wears have been investigated and also agricultural workers' work conditions have been observed. In the view of these data, 4 unisex work wears with different model properties have been designed and produced for agricultural industry. These unisex work wears are corresponding to size M for females and size S for males. All developed work wear samples were manufactured by using 100% Cotton fabric in the structure of gabardine and in the weight (the mass per unit area) of 185 g/m^2.

2.3. Subjective wear trials

In the subjective wear trial tests; the body fit body movement comfort and functionality of these developed models have been evaluated subjectively.

In these trials, volunteers have worn the work wear and they have been asked to make the movements which were determinate in the protocol. After the protocol, volunteers have been instructed to fill the subjective scales which were created to evaluate body fit and movement comfort performance of the work wear during working. In these subjective scales, there were questions about model details and areal fitting of the work wear. The collected data have been statistically analyzed with the help of PASW Statistics 18 software.

Participants: 8 female and 8 male volunteers participated as subjects in the wear trials. All subjects were 22±5,5 years in age. The male subjects were 177,9±4 cm in height, 70±5 kg in weight and in size S. The female subjects were 161,4±5 cm in height, 56±3 kg in weight and in size M.

Test Protocol: In order to determine the movements used in the subjective wear trial protocol, most used movements of the agricultural workers in greenhouses and open fields were observed. After that, five body positions were specified which are;(Picture 1)

- Arms on the sides, freestanding position,
- Standing position, arms raised (180^o),
- Standing position, upper body bended with 90^o
- Crouching position,
- Walking position.

Figure1. Positions of the body

The subjective wear trial protocol was created as below. It was instructed to subjects to repeat this protocol for 4 developed work wear samples.

- Wearing work wear,
- Five times repeating the work cycle which includes all of the determined body positions,
- Scoring the scales.

3. Findings

3.1 The results of questionnaire study

According to the survey which was intended to determine the expectations of agricultural workers, 67% of the workers have stated that they use different work wear in open field and greenhouse, while 37% of the workers have stated that they use same work wear. Participants have been asked to rank 6 clothing properties according to their importance. In this ranking "1" meant most important and "6" meant least important. The distribution about this ranking is given in Table 1. When Table 1 is analyzed, it is obvious that "comfort" is the foremost work wear feature for participants.

Table 1. Expectations from work wears

	N	Mean	Std. Dev.
Dirty Repellency	100	3,85	1,855
Comfort	100	1,89	1,072
Insect Repellency	100	3,86	1,303
Durability	100	3,94	1,384
Model Properties	100	4,85	1,520

65% of the participants desired one-piece (jumpsuit) work wears while 35% of the participants wanted two-piece work wear. 55% of the participants have stated that they use protective clothing while they are applying pesticide. However, 45% of the participants have stated that they do not use protective clothing in the same case.

60% of the participants who uses protective clothing believe that the protection of the clothing is sufficient but 45% of them think otherwise. 91,7% of the workers who thinks protection of the clothing is sufficient uses them.

Moreover, the relationship between the opinions of workers about sufficiency of the protective clothing and if they use it or not, is statistically significant (χ^2=30,556; df=1; p=0,000).

53% of participants think that they may be exposed to occupational accidents while the rest thinks otherwise.

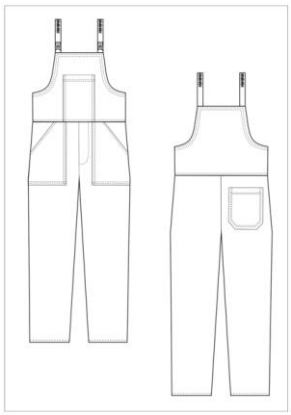
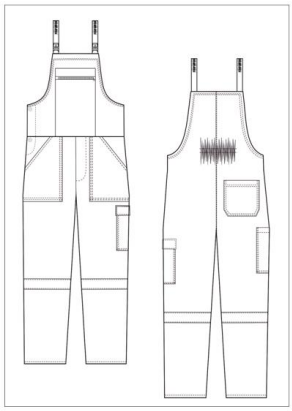
Participants have been asked that which tools they needed to carry with themselves from the list of 6 tools we have given. 84% of them replied gloves, 71% of them replied scissors, 87% replied cell phone, 49% replied pen and paper, 50% tape measure and 47% replied keys. This information was used to design number, size and place of the pockets of work wear.

67% of the participants think that uniforms must be used in work place while 33% of them think otherwise. Moreover, 75% of the participants claimed that they can get work wear as required, while 25% claimed that they cannot get work wear as required.

3.2. The work wear designs

Work wears with 4 different models have been designed and manufactured according to the data gathered from the survey and observations. Because 65% of the participants preferred wearing jumpsuit work wears during working in the field, the work wears have been designed as jumpsuit. Also the properties of the pockets which were used on the work wears have been also determined according to the obtained data from the questionnaire study. Pocket sizes have been changed in different work wears in order to obtain the most suitable one. Model details and technical drawings of developed work wears are given on Table 2 and size charts are given on Table 3.

Table 2: Developed work wears

No	Details of Models	Appearances of Models	Technical Drawings
Model 1	• Rubber was used inside the straps. • The straps were clipped with buckles. • There is a kangaroo pocket on the front panel. • The front and back body consists two parts. Two pockets are placed on the sides and one on the left back. • No zippers or buttons were used on the sides.		
Model 2	• Rubber was used inside the straps. • The straps were clipped with buckles. • The front body was built from two parts and the back was built from one part. • Elastic band was stitched over the waist line. Zipper was added on the kangaroo pocket which is placed on front panel. • One pocket was added on the right side of the back. • One capped pocket was added on the left side for carrying tools such as hedge shears. • The one side of the model consist two buttons. • Zipper placket was done on the front body.		

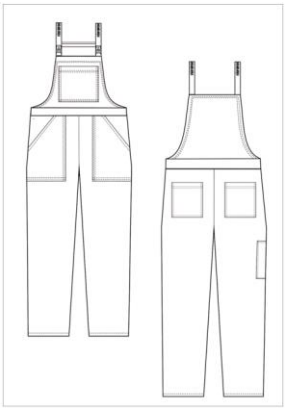
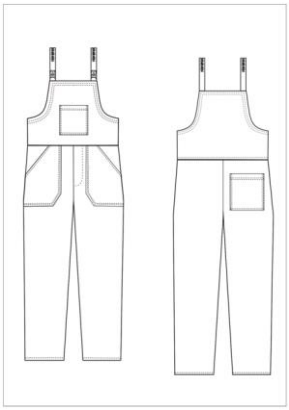
Model 3	• Rubber was used inside the straps. • The straps were clipped with buckles. • The front and the back body of the model were built as three parts which are panel, belt and lower body. • There is a kangaroo pocket on the front panel. • Two pockets were added on the sides, two on the back and one on the right side. • For easy wearing, a zipper was used on the right side.		
Model 4	• Rubber was used inside the straps. • The straps were clipped with buckles. • There is a kangaroo pocket on the front panel of the model. • The front and back body consists two parts. • Two pockets were added on the sides, one on the right side of the back. • For easy wearing, a zipper was used on the right side.		

Table 3. The Measurements of Developed Work Wear Models

Measurements (cm)	Model 1	Model 2	Model 3	Model 4
Waist Width	44	46	45	47
Hip Width	51	54	52	53
Thigh Width	30	34	31	32
Front Crotch Depth	26	28	25	27
Back Crotch Depth	39	71	38	40
Knee Width	25	26	23	24
Bottom Width	20	21	20	20
Front Panel Upper Width	19	24	21	18
Front Panel Lower Width	44	45	37	45
Front Panel Middle Length	29	33	20	28
Front Panel Side Length	11	10	3	12
Front Panel Pocket Width	20	21	20	20
Front Panel Pocket Length	20	18	17	16

Back Panel Upper Width	18	16	20	19
Back Panel Lower Width	45	51	36	47
Side Pocket Upper Width	8	7	6	5
Side Pocket Lower Width	17	16	15	13
Back Pocket Width	17	14	17	15
Back Pocket Length	20	16	15	17
Strap Width	3	3	3	3

3.3. The effect of model details to body movement comfort and functionality

Repeated measure ANOVA was used in order to evaluate the differences between the acclaims of volunteers about properties of the models. According to the results of this evaluation, it was found that there is no statistically significant difference between model details and fitting properties. Furthermore, paired comparisons of the models were done in conformity of 2-Related Sample method. It was obtained that, there was a statistically significant difference between easy wearing features with respect to the models (p=0,016). There weren't statistically significant differences between models and other remained features.

Mean values of scores that volunteers gave to the questions about model properties are given on Table 4. In quinary likert scale, I don't agree absolutely was coded as 1, I don't agree was coded as 2, I have no idea was coded as 3, I agree was coded as 4 and I absolutely agree was coded as 5.

Table 4: The factors about model properties of the developed work wears

		Model 1			**Model 2**			**Model 3**			**Model 4**		
		N	**Mean**	**Std Deviation**	**N**	**Mean**	**Std Dev.**	**N**	**Mean**	**Std Dev.**	**N**	**Mean**	**Std Dev**
1	I am satisfied with fitting of upper body	16	3,88	1,408	16	**4,13**	1,310	16	3,50	1,461	16	3,19	1,377
2	I am satisfied with fitting of waist part	16	**4,06**	1,063	16	3,81	1,377	16	**4,06**	0,854	16	3,25	1,183
3	I am satisfied with fitting of hip part	16	3,69	1,662	16	3,56	1,459	16	**3,94**	0,929	16	3,81	0,981
4	I am satisfied with fitting of back and front crotch	16	**4,13**	1,204	16	**3,95**	1,438	16	3,50	1,461	16	3,88	1,088
5	I am satisfied with fitting of upper leg part	16	**4,13**	1,147	16	**4,19**	0,981	16	3,88	1,025	16	3,81	1,109
6	I am satisfied with fitting of knee part	16	3,81	1,328	16	**4,50**	0,816	16	**4,25**	0,931	16	**4,19**	0,834

7	I am satisfied with fitting of straps	16	**3,94**	1,237	16	3,56	1,263	16	3,31	1,580	16	**3,94**	1,389
8	I am satisfied with side	16	3,38	1,586	16	3,25	1,291	16	3,75	1,291	16	**4,31**	0,873
9	I am satisfied with the size of pockets	16	**3,88**	1,025	16	**3,88**	1,204	16	3,75	0,931	16	3,44	1,365
10	I am satisfied with the places of pockets	16	3,94	1,181	16	**4,31**	0,793	16	3,88	1,025	16	**4,00**	1,265
11	I am satisfied with the count of pockets	16	3,94	1,063	16	**4,19**	0,750	16	3,69	1,401	16	3,69	1,250
12	I had no difficulty wearing	16	3,75	1,571	16	**4,50**	0,516	16	**4,25**	1,183	16	**4,56**	0,629
13	I am satisfied with the appearance	16	**4,31**	0,793	16	**4,38**	0,885	16	3,94	1,237	16	3,50	1,211
14	I am satisfied with the body movement comfort	16	3,88	1,088	16	**4,25**	0,856	16	**4,06**	0,998	16	**4,06**	0,680
15	I am satisfied with accessories (zipper, button, claps)	16	3,75	1,183	16	3,94	0,854	16	3,88	1,025	16	**4,13**	1,025

According to the results, 50% of the volunteers were highly satisfied with upper body of model 2 (Mean=4,13), while 38% of them were satisfied with the hip part of the same model (Mean=3,94). Furthermore, 44% of the same volunteers were satisfied with fitting of thigh part of model 3 (Ort=4,19), while 63% of them were also highly satisfied with fitting of knee part of the same model (Mean=4,5). Most of the subjects were satisfied with waist part of model 1 and 3 (Mean=4,13).

About the front and back crotch which are thought to be two of the most important criteria of fitting, 50% of the subjects were satisfied with model 1 (Mean=4,13). 50% of the volunteers were highly satisfied with the side of model 4 (Mean=4,31).

In terms of pocket properties, 50% of the volunteers were satisfied with the sizes of models 1 and 2 (Mean=3,88) while model 2 were their first choice about the pocket count (Mean=4,31) and place (Mean=4,19). 63% of the volunteers stated that they had no difficulty in wearing model 4 (Mean=4,56) and 44% of them also stated that they liked the accessories of the same model (Mean=4,13). 56% of the volunteers were satisfied with the appearance of model 2 (Mean=4,38), and 44% were satisfied with general usage properties of the same model (Mean=4,13).

Additionally, in the evaluation of model properties, differences of female and male volunteers were also investigated because models we developed were unisex. It was determined that, there were statistically significant differences between participating woman and man in aspect to places of pockets (p=0,006) and counts of pockets (p=0,03) of

model 1 (Table 5). When compared to men, women were more satisfied from the places of pockets and also counts of pockets of model 1.

It was also obtained that, there were statistically significant differences between participating women and men with respect to sizes of pockets (p=0,032) and count of pockets (p=0,036) of model 4 (Table 6). When compared to men, women were more satisfied from the sizes and the counts of pockets. There was also a statistically significant difference between participating woman and man with respect to having no difficulty in wearing the work wear of model 4 (p=0,003). When compared to men, women had less difficulty in wearing model 4.

Table 5. Participating women and men in aspect to model details of Model 1

Model Details	Gender	N	Mean Rank	Sum. Of Ranks	Z	MWU	Sig. (2-tailed)
Places of Pockets	Women	8	11,63	93,00	-2,774	7,000	0,006
	Men	8	5,38	43,00			
Count of pockets	Women	8	10,88	87,00	-2,176	13,000	0,03
	Men	8	6,13	49,00			

Table 6. Participating women and men in aspect to model details of Model 4

Model Details	Gender	N	Mean Rank	Sum. Of Ranks	Z	MWU	Sig. (2-tailed)
Size of pockets	**Women**	**8**	**10,88**	**87,00**	**-2,148**	**13,000**	**0,032**
	Men	**8**	**6,13**	**49,00**			
Count of pockets	**Women**	**8**	**10,81**	**86,50**	**-2,100**	**13,500**	**0,036**
	Men	**8**	**6,19**	**49,50**			
No difficulty in wearing	**Women**	**8**	**11,50**	**92,00**	**-2,954**	**8,000**	**0,003**
	Men	**8**	**5,50**	**44,00**			

4. CONCLUSION

In this study, the main goal was to develop work wear for farm workers which provide functionality and ease of use, increase productivity and has high body movement comfort. Results of the survey study which was done to farm workers has shown that 67% of the volunteers thinks that they should wear a special work wear in the work place and this work wear should be comfortable. These results are reasonable due to their long and non-regular work hours in this line of work. Starting from this, body fit of the work wear became our primary goal. 4 models were designed and manufactured with similar measurements within this study.

One of the critical parts at which we should be careful about for body fit was the crotch of the work wear we were developed, as it was planned as jumpsuit. It is important that there must not be tension on the crotch part while moving and work wear should not restrict movement. For this reason, in our models, extra ease allowance was added to all 4 models in order to increase body movement comfort. Furthermore, elastic bands were added inside strap fabrics to prevent tension on the crotch during bending forward and sides, crouching and reaching movements. In every model straps were clipped with buckles.

Front and back panels of the jumpsuits were designed with different sizes. Subjective wear trials showed that the favorite model according to upper body fitting was model 2 which had the biggest front panel. Moreover, straps should be longer if the front panel is short and this would lead discomfort on shoulders and more tension on the crotch during movement.

In our research, we obtained that, there wasn't statistically significant difference between model details with respect to developed 4 models. However, when the mean scores of model details were evaluated, it can be seen that, the favorite model according to upper body fitting was model 2 which had the biggest front panel.

With respect to these data, it can be said that, the volunteers were more satisfied from places, counts and sizes of pockets and general

appearance of model 2. The back body was built from one part in model 2. We thought that this could cause tension on the crotch, with respect to the mean scores of this feature. Besides, elastic band was stitched over the waist line of the model 2 for enhancing movement capacity of the wearer. Nevertheless, it was obtained that, there was a statistically significant difference between easy wearing features with respect to the models. The volunteers gave lowest score to the side of model 2. It has been thought that, the reason is because the volunteers would prefer zipper on the side instead of buttons. In model 1, there was no accessory on the side. Therefore, the volunteers had difficulty in wearing this model.

Work wears were designed as unisex. In the subjective wear trials both male and female workers were dressed up and their content levels were determined. When the subjective scale results were evaluated, it was found that, there weren't statistically significant differences between participating woman and man in aspect to model details of model 2 and model 3. It was also determined that, there were statistically significant differences between participating woman and man in aspect to places of pockets and counts of pockets of model 1 and sizes of pockets and count of pockets of model 4. When compared to men, women were more satisfied from the places of pockets and also counts of pockets of model 1. In addition to this, women were more satisfied from the sizes and the counts of pockets of model 4. The pocket sizes and counts of model 2 had the highest mean scores. Thus, for designing unisex work wears, in a large number of pockets and also big pockets can be chosen like model 2.

There was also a statistically significant difference between participating woman and man with respect to having no difficulty in wearing the work wear of model 4. When compared to men, women had less difficulty in wearing model 4. Nevertheless, when the mean scores of "having no difficulty in wearing" of 4 developed models were analyzed, it was obtained that model 4 had highest score. Therefore, it can be said that, although there was a statistically significant difference between gender and having no difficulty in wearing model 4, this situation doesn't affect manufacturing the work wears as unisex.

Subjective wear trial results show that generally there are no critical problems in our 4 models, concerning upper body, hip, waist and crotch fittings. Also, we come to the conclusion that unisex work wears for farm workers can be designed. In conclusion, we think that companies producing work wear for farm workers should consider data of this study for designing their clothing.

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