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Assessment of agriculture technologies for use in arid regions of Egypt

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Abstract. The study was carried out in the coastal zone of Western Desert of Egypt (CZWD), which extends from Alexandria at the East to Libyan border at the West. It is classified as an arid zone. The agro-pastoral production system prevails in this area. This system is facing more frequent droughts whose effects are worsened by human activities. Over the last two decades, goat breeding and nutrition technologies were implemented in this area in order to improve goat productivity and profitability. A survey was conducted with 262 Bedouins, aiming to analyze the potential impact of such alternative technologies, highlighting the socioeconomic factors that affect the adoption of these technologies In Egypt. Bio-economic data were collected and submitted to cost-benefit analysis. Results showed that under drought conditions the high rate of kids mortality (22.2%) is the major constrain limiting productivity. The financial analysis of goat production revealed a break even. Replacement of Barki goats by Damascus crossbred increased profit/doe by LE 64.4. On the other hand, enhance nutritive value of crop byproducts decreased cost/doe by LE 54.4.The average adoption of goat production technology was 48.5%. Bedouins adopted breeding technology (74%) and nutrition technology (23%). Adoption of the technology is significantly affected by Bedouins education level, contact with extension agents and total area of owned land. Infrastructure and support services must be established to enable such technologies to succeed and reach small-scale breeders.

Keywords. Agro-pastoral system – Small ruminants – Drought – Developments projects.

Évaluation des technologies agricoles pour son utilisation dans les régions arides de l'Égypte

Résumé. *L'étude a été menée dans la zone côtière du désert occidental de l'Egypte (CZWD), qui s'étend de l'Est à Alexandrie jusqu'à la frontière de la Libye à l'ouest. La zone est classée comme zone aride et le système de production agro-pastorale prédomine. Ce système a été confronté par la sécheresse qui est devenue plus fréquente et aggravée par les activités humaines. Au cours des deux dernières décennies, les technologies de reproduction et de nutrition des chèvre ont été implementéess afin d'améliorer la productivité de chèvre et la rentabilité. Une enquête a été menée avec 262 Bédouins visant à analyser l'impact potentiel de ces technologies alternatives et de mettre en évidence les facteurs socio-économiques qui affectent l'adoption de ces technologies en Egypte. Des données bio-économiques ont été prélevées et soumises à un analyse de coûts-avantages. Les résultats ont montré que dans des conditions de sécheresse, le taux élevé de mortalité des chevreaux (22,2%) est le principal contrainte limitant la productivité. L'analyse financière de la production caprine a révélé un seuil de rentabilité. Le remplacement d'une chèvre Barki par une de race Damas augmente le profit/chevre de 64,4 LE. D'autre part, l'amélioration de la valeur nutritive des sous-produits agricoles a diminué le coût/chevre en 54,4 LE. Le taux moyen d'adoption de la technologie de production de chèvre est de 48,5%. Les bédouins adoptent la technologie d'amélioration génétique (74%) et la technologie d'amélioration de la nutrition (23%). L'adoption de la technologie est fortement influencée par le niveau d'éducation des Bédouins, le contact avec les agents de vulgarisation et la superficie totale des terres en propriéte. Des services d'infrastructure et de soutien doivent être mis en place pour permettre ces technologies à réussir et à atteindre les petits éleveurs..*

Mots-clés. *Système agro-pastoral – Petits ruminants – Sécheresse – Projets de développement.*

I – Introduction

The study was carried out in the coastal zone of Western Desert of Egypt (CZWD), which extended from Alexandria East to Libyan border west. It is classified as arid zone. The agro-pastoral production system prevails in this area. This system has been faced by drought that has become more frequent and worsened by human activities. There are some one million heads of sheep and goats, whish contribute substantially to the Bedouins income and nutrition, and are used as subsistence and survival reserve in years of drought. Barki is the only goat breed raised on CZWD. Over the last two decades, goat breeding and nutrition technologies were implemented in this area in order to improve goat productivity and profitability. Utilization of Damascus goat as a more developed breed native to the Middle East was considered as a possible mean for developing the productive potentiality of Barki goats. Damascus goats were first introduced in CZWD in 1984. Three batches of 67 Damascus bucks were imported from Cyprus and distributed to the breeders over the area. The bucks were given to the breeders on loan basis with the help of an American International AID grant project. Over the period 1994-1999 another batch of 10 pure Damascus and 15 crossbred Damascus × Barki bucks were distributed by Marsa-Matroh National Resources Project (supported by the World Bank).The work was continued since then by the breeders themselves. To improve the nutritive value of crop residues, urea and ammonia treatments of straw was developed for use in CZWD. Several institutions including Animal Production Research Institute, the European Union, the Finnish Government and the International Development Research Center were involved in the project. This study aimed to analyze the potential impact of such alternative technologies, In addition, highlighting the socioeconomic factors that affect the adoption of these technologies in Egypt.

II – Materials and methods

A survey was conducted with 262 Bedouins in the coastal zone of Western Desert of Egypt (CZWD). The sample represented most Bedouins targeted by the goat production technologies. The field survey was based on a socio-economic questionnaire. The study covers 122 Bedouins exposed to only breeding technology, 103 Bedouins exposed only to nutrition technology and 37 Bedouins exposed to the two technologies. Monthly visits were conducted to 30 flocks to take repeated measurements of reproductive performance and kid's body weights. Least squares analyses of variance were conducted using the general linear model procedure of (SAS, 1990). The rate of each technology adoption model is implicitly specified as follows:

$$Y = f(X1, X2, X3, X4, X5, X6, X7, X8, e\}$$

Where, Y = rate of adoption expressed as Yi = 1 if the breeder adopt (Bedouin who use technology in any year after year of demonstration) and Yi = 0 if not adopt, X1 = Farm size, X2 = household size, X3 = household age, X4 = education levels, X5 = Flock size, X6 = Financial incentives, X7 = Marketing distance, X8 = availability of labor, X9 = Off-farm job, and X10 = Extension services.

Cost-benefit analysis was performed using Microsoft Excel spreadsheet. The financial analysis accounted only for paid expenditures, as feeding and veterinary costs and some other miscellaneous items. Average input and output prices were estimated based on the actual market value paid by farmers to purchase these items. The fixed costs were assumed nil since houses are made of available and cheap materials and no special equipments are needed.

III – Results and discussion

The effects of drought on the goat flock performance are presented in Table 1. Higher rate of kids mortality (22.2%) is the major constrain limiting productivity. Under the situation of degraded rangelands, feed expense is a major goat production constraint limiting profitability. The financial analy-

sis of goat production revealed a break even. Replacement of a Barki goat by Damascus crossbred increased Profit/doe by LE 64.4. On the other hand, enhance nutritive value of crop byproducts decreased cost/doe by LE 54.4.The average adoption of goat production technology was 48.5%. Table 1 revealed that Bedouins adopted breeding technology (74%) and nutrition technology (23%).

Table 1. Performance of Barki goats under drought conditions

Criteria	Current situation	Impact of technologies†	
		Breeding††	Nutrition†††
Production performance:			
Litter size at birth	1.25 ± 0.1		
Kid mortality (0-4 months), %	22.2 ± 0.7		
Kid weight at 4 months	14.31 ± 0.4		
Productivity††††	16.70 ± 0.4		
Financial analysis:			
Cost/doe, LE	364.9	47.5	-54.4
Revenue/doe, LE	379.4	112.3	-7.8
Profit/doe, LE	14.4	64.4	46.6
Adoption of technology, %		74	23

† Impact is accounted for annual total costs and revenues above the current situation; †† breeding technology = replacement of a Barki goat by Damascus crossbred; ††† nutrition technology = enhance nutritive value of crop byproducts using urea/ammonia; †††† kg kids production/doe/year.

Most of farm and household characteristics showed a positive and significant relationship with Bedouins adoption of nutrition technology, except off-farm job showed negative relationship (Table 2). Extension services play a crucial role in creating awareness among farmers of the impact of nutrition technology in terms of yields and income.

Table 2. Factors affecting Bedouins adoption of goat production technologies

Factors	Breeding technology†		Nutrition technology††	
	Relationship	Pr>F	Relationship	Pr>F
Farm characteristics:				
Farm size		NS	Positive	P<0.05
Flock size		NS	Positive	P<0.01
Financial incentives	Positive	P<0.01	Positive	P<0.01
Extension services		NS	Positive	P<0.05
Marketing distance		NS		NS
Availability of labor		NS	Positive	P<0.01
Household Characteristics:				
Age		NS	Negative	P<0.05
Education levels	Positive	P<0.05	Positive	P<0.01
Family size		NS	Positive	P<0.05
Off-farm job		NS	Negative	P<0.05

† Breeding technology =replacement of a Barki goat by Damascus crossbred; ††Nutrition technology = enhance nutritive value of crop byproducts using urea/ammonia.

On the other hand, all farm characteristics (except financial incentives and education level) non-significantly affected Bedouins adoption of breeding technology. These results indicate that whatever differences in characteristics between the farms they did not seem to cause significant variation in the adoption. Prokopy *et al.* (2008) showed that education levels, capital, income, farm size, access to information, positive environmental attitudes, environmental awareness, and utilization of social networks were positively associated with adoption and use of technology. Sulo *et al.* (2012) showed that primary occupation, annual income and household size had a positive and significant associated with agriculture technologies adoption. Pannel *et al*. (2006) indicated that the adoption of agriculture technology depends on a range of personal, social, culture and economic factors.

In relation to breeding technologies', Khanal and Gillespie (2011) reported that in the US dairy sector specialized, younger, more educated farmers are more likely to adopt advanced breeding technologies such as AI, sexed semen, and embryo transplants. Howley *et al.* (2012) suggested that both characteristics of the farmer as well as structural farm factors found to significantly affect of the probility of a farmer adopting artificial insemination agricultural innovations.

The analysis of constraints' revealed that 20% and 23% of Bedouins perceived Damascus adaptation and seasonality to be major constraints (Table 3). The high feed requirements' was another problem as it increased feeding cost. As indicated by the breeders, the most important constraints in the adoption of this technology are high price of Damascus bucks. The challenge is to develop mechanisms to provide poor farmer with Damascus bucks, either through credit loans or through livestock breeders associations, whose objective is to help smallholders who have production capacity but lack the resources to buy livestock.

Table 3. Advantages and constraints of the goat breeding technology as indicated by the breeders

Advantage	Percentage	Constraints	Percentage
– Heavy body weight	34%	– Adaptation	20%
– High milk production	28%	– Seasonality	23%
– High selling price	29%	– Require more inputs	14%
– No answer	9%	– High buying price	35%
		– No answer	8%

Previous research has found that the cost of agriculture technology and success rate affect the probability of farmers using it (Vishwanath, 2003).

Urea treatment appeared to be a cost- effective technology and the Bedouins were satisfied with the results. The Bedouins could not monitor growth rates. The major constraints to use of the nutrition technology (Table 4) were the cumbersome and labor-demanding aspects of the treatment, and then the marginal returns, requirements of large quantities of clean water and covering material. The technology may prove to be successful if it is operated on a collective basis as a community project, as is done in China and Vietnam. It may be difficult for an individual resource-poor farmer to adopt this technology. The technology needs to be refined further, technically and made simpler for the farmer.

Table 4. Advantages and constraints of the goat's nutrition technology as indicated by the breeders

Advantage	Percentage	Constraints	Percentage
– Increased feed intake	38%	– Material is expensive	17%
– Decrease feeding costs	47%	– Availability of straw	8%
– Increased growth rate	6%	– Availability of water	16%
– Increased milk yield	9%	– Labor intensive	37%
		– Marginal return	23%

IV – Conclusion

Although nutrition technology for enhance nutritive value of crop by-products started several decades ago in northwestern coastal zone of Egypt, sustained adoption by Bedouins has generally been poor. An important reason is that adoption of nutrition technology is constrained by many of household and farm characteristics as well as on the characteristics of the innovation itself. Extension services play a crucial role in creating awareness among farmers of the impact of technology in terms of yields and income. The results confirm also the importance of focusing on producer education as a component in influencing technology.

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